

July 15, 1952

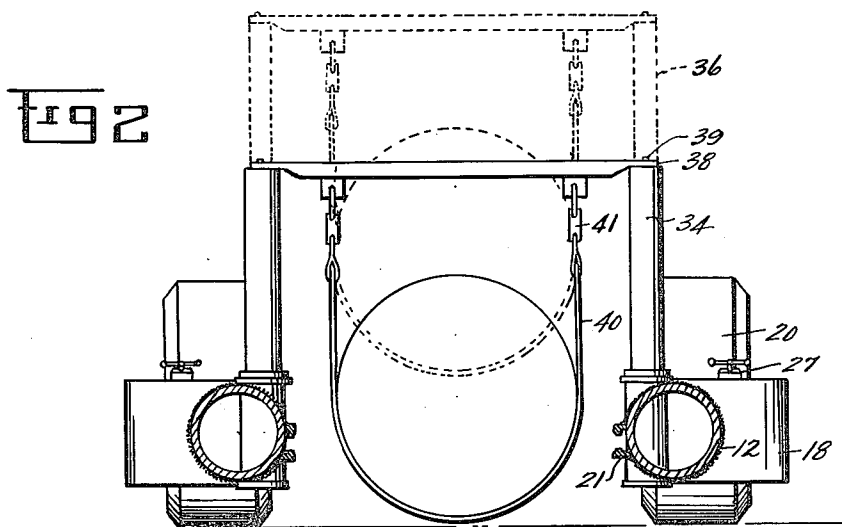
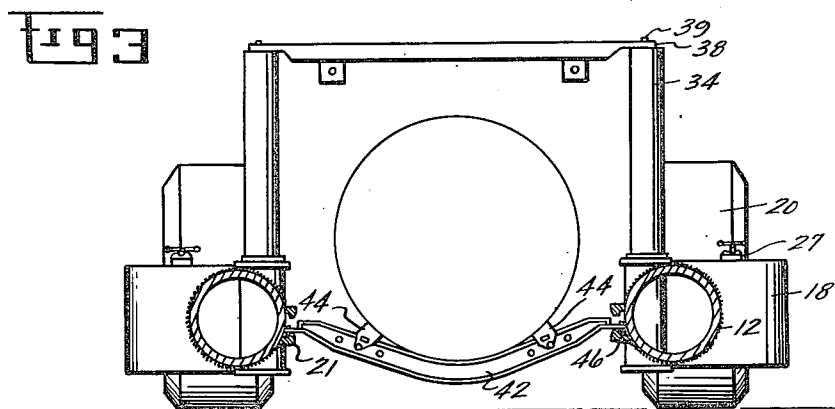
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HYDRAULIC BOMB LIFT TRUCK

Filed Nov. 28, 1949

6 Sheets-Sheet 2



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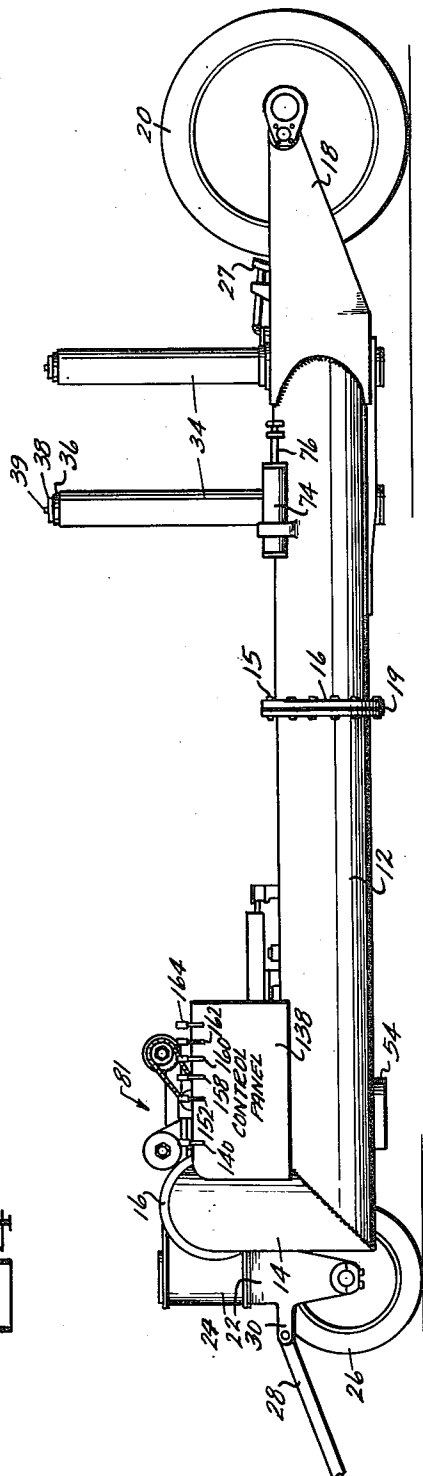
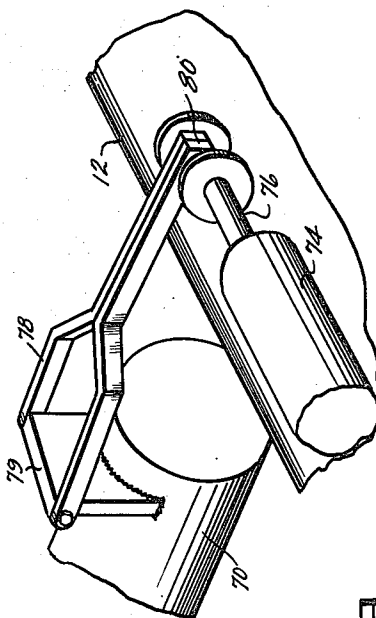
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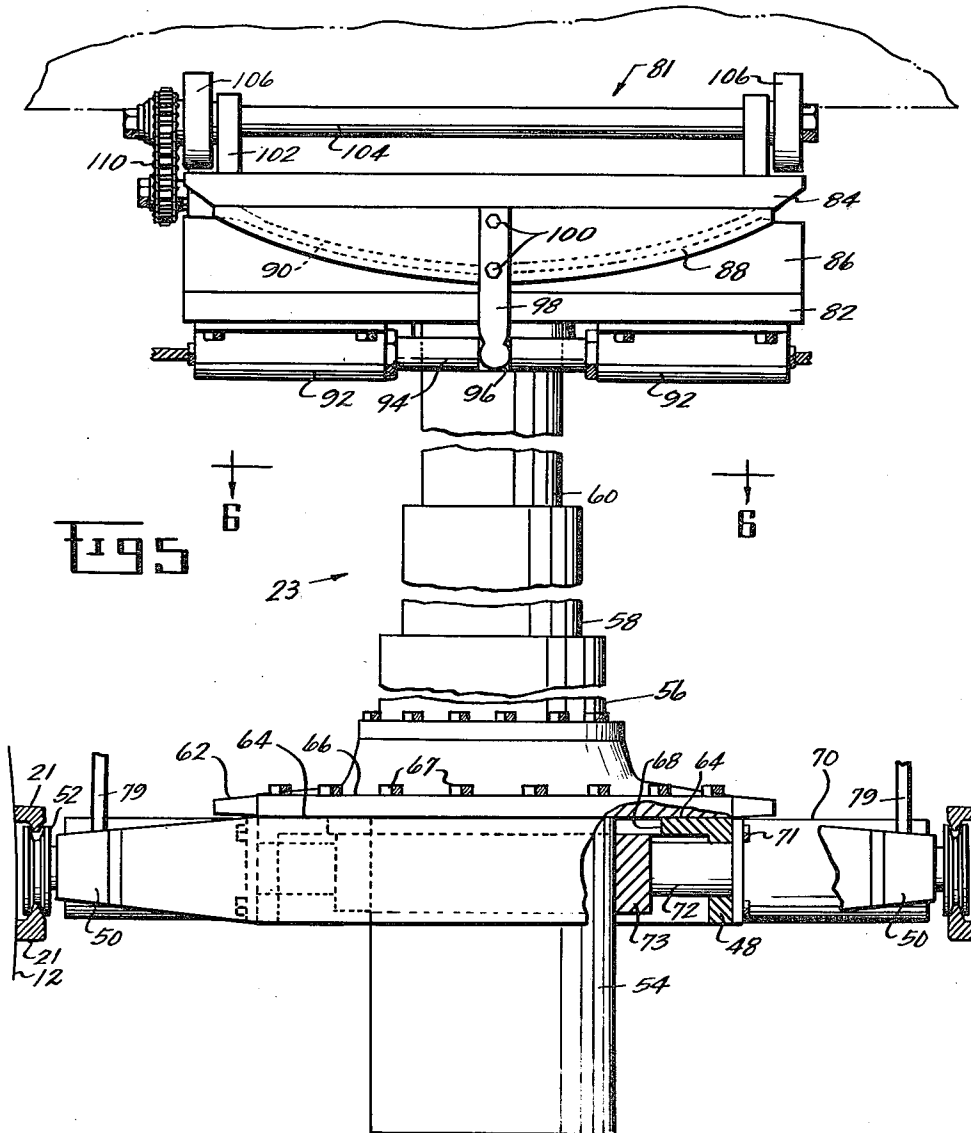
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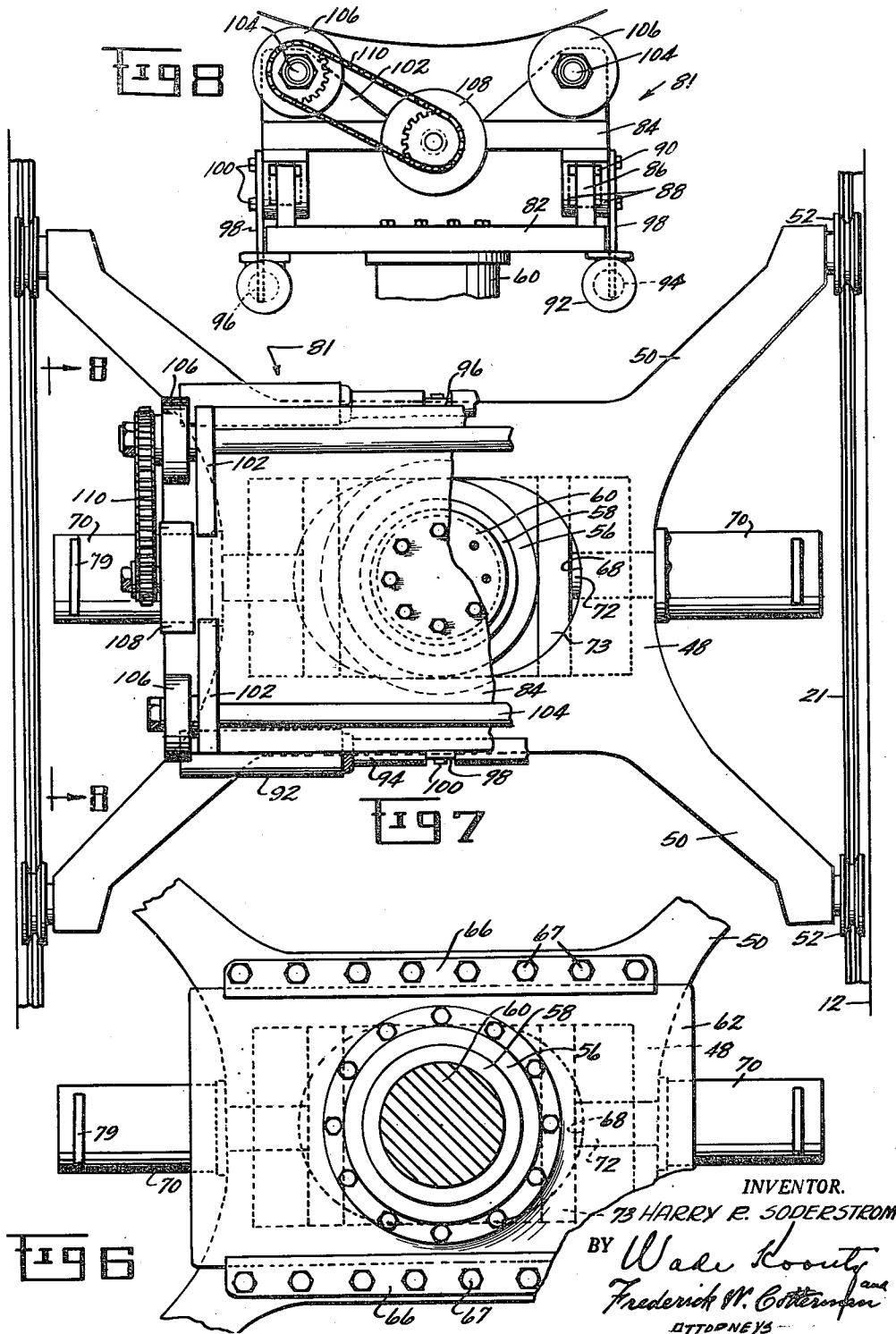
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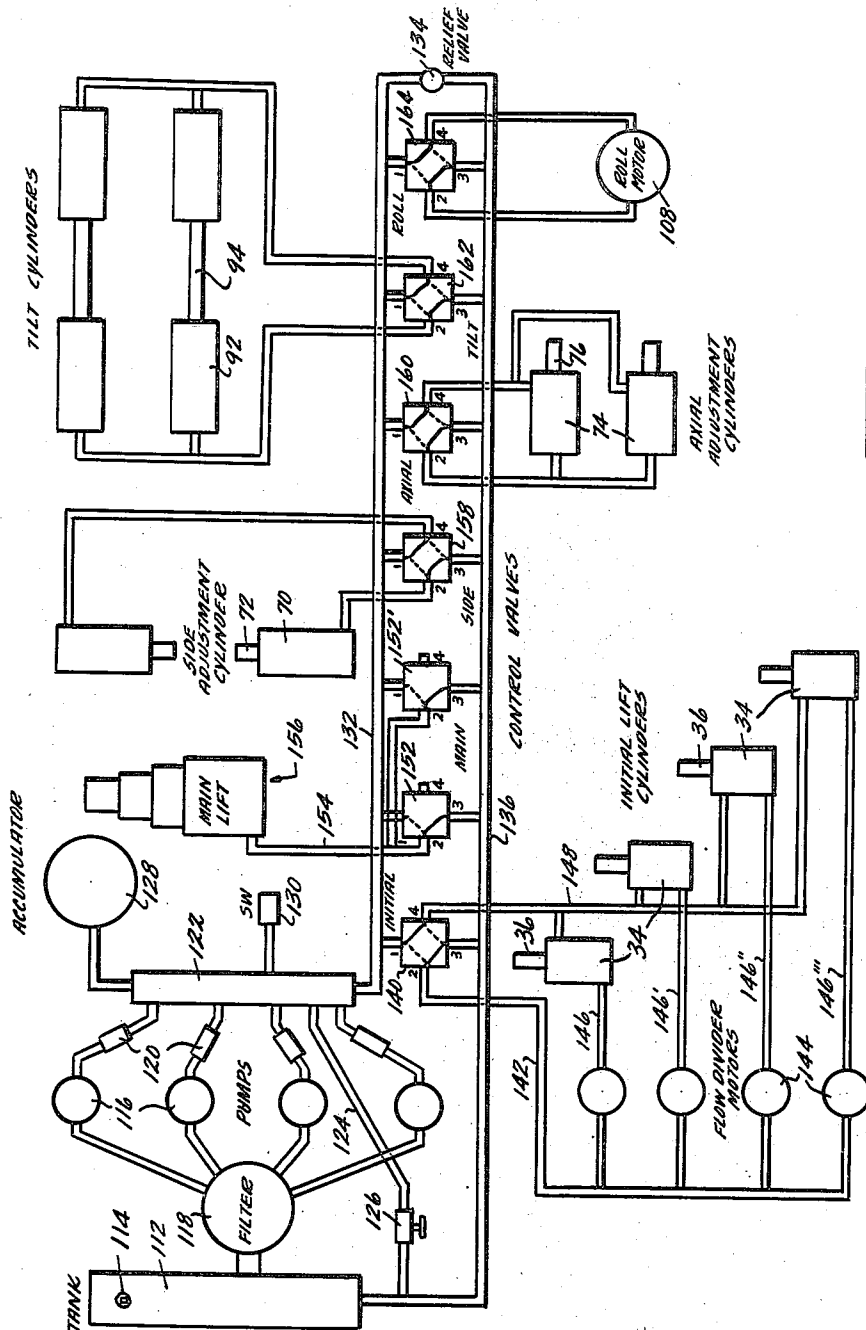


FIG 10

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HYDRAULIC BOMB LIFT TRUCK

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Application November 28, 1949, Serial No. 129,789

9 Claims. (Cl. 214-75)

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This invention relates to bomb lifts and particularly to lifts for handling bombs of extremely heavy weight and large dimensions.

The principal object of the invention is to provide a bomb lift by means of which a bomb of the order of twenty or more tons and ranging from as much as thirty-two to fifty-four inches in diameter and one hundred twenty inches from nose to center of gravity of the bomb, may be taken from the ground, transported to a loading place, raised into the bomb bay of an aircraft then shifted axially or transversely, rolled on its axis or tilted nose up or nose down in small amounts as required to bring the shackles by means of which the bomb is to be hung into proper position for releasable fastening.

This object is accomplished by mounting on a large specially constructed truck one lifting means near the rear end for raising the bomb off the ground and a second lifting means near the front end which may be moved under the bomb after it has been raised a sufficient distance off the ground. The first lifting means is adapted for vertical movement only, while the second lifting means is constructed and arranged to first raise the bomb into the bomb bay then move the bomb in small amounts in any one of a number of directions to facilitate the bringing together of the engaging parts of the shackles. Additionally the device is constructed and arranged for ease in dismantling for transportation to a distant seat of operations.

Advantages and meritorious features will become evident as the invention is described in greater detail, reference being had to the drawings, wherein:

Fig. 1 is a top plan view of the bomb lift, which is the subject of this application, shown with the frame of the lift astride the bomb which is to be lifted, the initial lifting beams and the transporting beams being shown in position and the main lift being stored at the front of the truck where it is kept locked in position when it is not being used to load the bomb on to an aircraft.

Fig. 2 is a transverse section taken at 2-2 of Fig. 1 but with the transporting beams removed and the initial lifting beams in place on the ends of the pistons with slings or straps extending from one end of an initial lifting beam down and around the bomb and back to the other end of the initial lifting beam, the dotted lines indicating the position of the bomb and the apparatus after the bomb has been lifted some distance off the ground.

Fig. 3 is a transverse section taken at 3-3 of

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Fig. 1 showing the transporting beams in place on, and supported by, the side rails of the truck frame, the sling being removed from the initial lifting beams which are now in their home position.

Fig. 4 is a side elevation of the complete bomb lift shown in Fig. 1.

Fig. 5 is an elevation of the main lift assembly drawn to an enlarged scale as viewed from the line 5-5 of Fig. 1.

Fig. 6 is a top plan view, partly in section of the main lift carriage, and its transverse adjusting means as seen from the line 6-6 of Fig. 5.

Fig. 7 is a top plan view of the main lift shown in Fig. 5, part being broken away to show the top surface of the main lift carriage.

Fig. 8 is a front elevation of the rolling and tilting cradle, which is carried on the top of the main lift, viewed from the line 8-8 of Fig. 7.

Fig. 9 is an enlarged perspective view of the means provided for making minor longitudinal adjustments of the main lift.

Fig. 10 is a schematic diagram of the entire hydraulic system employed in the operation of the lift herein disclosed.

Referring to the drawings and more particularly to Fig. 1, the main frame 10 consists of right and left tubular side members 12 connected together at the front end only by a cross member 14. The tubular side members 12 are each made in two parts joined by flanges 16, the front end of each side member being formed first upward then inward as shown, then joined to the cross member by a second pair of flanges 16. The flanges being joined together by bolts 15, permits easy disassembling of the truck frame for transportation to a distant seat of operations. Moreover, by placing solid discs of suitable thickness between the two flanges of a joint and between the two flanges of a spaced apart joint as at 17 and 19, a hydraulic storage tank is provided. Rails 21 are provided along the inside of the side members 12 for moving a main lift 23 from a stored position into position under the bomb. A carriage lock 25 (see Fig. 1) is provided for holding the main lift in the stored position.

The rear ends of the side members 12 are provided with forked rear wheel supports 18 each having rotatably mounted therein a rear wheel 20. Brakes 27 are provided for each rear wheel whereby the truck may be locked against movement or retarded in down hill travel. A single forked front wheel support 22 is pivotally mounted in a pivoting wheel bracket 24 which is permanently attached to the cross member 14,

whereby the front wheel 26 is mounted both for rotation and for turning about a vertical axis. Tow bars 28 are hinged to tow bar brackets 30 which extend from the forked wheel support 22. A tow ring (not shown) on the end of the tow bar provides attaching means by which the truck may be pushed, pulled or guided.

Except by the front cross member 14, the side members 12 are not otherwise permanently connected together. This construction permits the truck to be backed astride the bomb as seen in Fig. 1.

Near the rear end of the main truck frame 10 are four relatively small initial lift cylinders 34, two on each side member 12 to which they are permanently secured preferably by welding. These cylinders may appropriately be called the initial lift cylinders since they may be operated to initially lift the bomb high enough to allow the main lift to be moved along the tracks 21 to a position under the bomb. Each cylinder 34 is provided with an initial lift piston 36 which is vertically slidable therein.

To carry out the initial lifting operation, two initial lift beams 38 are provided and arranged crosswise of the frame, the ends of the beams having openings which fit over integral dowels 39 on the upper ends of the pistons. Strap steel slings 40 are adapted to be passed under the bomb and the free ends fastened to the lift beams by the chain ends 41 (see Fig. 2).

For transporting the bomb the transport beams 42 are provided, the outer ends resting on the tracks 21 and the space intermediate being provided with chocks 44 movable to different positions for holding bombs of different diameters (see Fig. 3). Retaining pins 46 hook in back of the rails to prevent movement of the transport beams 42 transversely of the truck frame.

The main lift 23, Fig. 1, is mounted on a carriage 48 (see Fig. 5) having four legs 50 with a roller 52 at the end of each leg positioned for rolling along the rails 21 carrying the lift 23 from its stored position shown in Fig. 1 to its operating position centered axially and transversely with the four initial lift cylinders 34, this position of the main lift being under the center of gravity of the bomb.

The main lift 23 comprises four telescoping cylinder sections 54, 56, 58 and 60 each section except the lowermost section 54 acting as a piston for the cylinder section next below it. The lower section 54 is provided with a rectangular flange 62 which rests on and is slidable over the upper surface 64 of the carriage and is guided for transverse movement of the flange with respect to the carriage by gibs 66 which are retained by the screws 67. The rectangular flange 62 is positioned a short distance from the upper end of the cylinder section 54. An oval opening 68 in the carriage 48 permits transverse movement of the lower cylinder section 54 with respect to the carriage. Opposite horizontally disposed cylinders 70 are permanently secured to the carriage 48 by screws 71, and pistons 72 are slidable in the cylinders 70 and have their free ends abutting bars 73 which lie against the lower cylinder section 54, thus providing a means for hydraulically moving the lower cylinder section 54 and with it its flange 62 and the remaining cylinder sections 56, 58 and 60 transversely of the truck frame by sliding the flange 62 backward or forward in the gibs 66 (see Fig. 6). Cylinders 70 may be appropriately designated "transverse control cylinder."

A pair of small cylinders 74 having pistons 76 are rigidly fastened one to each side member 12, and so positioned thereon that when the main lift 23 is rolled rearward on the rails 21 to its lifting position, yokes 78 hinged on brackets 79 which extend upwardly from the cylinders 70 may be swung into a position with the free end 80 in a groove in the end of piston 76 (see Fig. 9). With the yoke 78 thus positioned, limited longitudinal adjustment of the main lift may be had by hydraulic manipulation of the pistons 76. Cylinders 74 may properly be called the "longitudinal adjustment cylinder."

The cradle 81, which is provided at the upper end of the main lift for holding the bomb and tilting it nose up or nose down or rolling it on its axis, comprises a lower platen 82 rigidly affixed to the upper end of the top cylinder section 60, an upper platen 84 positioned above the platen 82, the lower platen 82 having upwardly extending concave ways 86 and the upper platen 84 having downwardly extending convex ways 88 slidably fitted to the concave ways 86. T-shaped ribs formed along the edge of the ways 86 are slidable in T slots 90 formed in the ways 88 thus holding the ways 86 and 88 in sliding engagement (see Fig. 8).

Tilting cylinders 92 are carried on the underside of the lower platen 82 and an elongated piston 94 is slidable in both cylinders. Piston 94 has a vertical notch 96 which receives the lower end of a lever 98 which is fastened to the side of the way 88 by bolts 100, whereby movement of the piston 92 tilts the upper platen 84 forward or backward.

Brackets 102 extend upwardly from the upper platen 84 to provide bearings for the shafts 104 which carry rollers 106 at the outer ends upon which the bomb rests as it is being elevated. A small motor 108 which may be called the roll motor drives one of the shafts 104 by means of a chain drive 110, whereby the bomb may be rotated on its axis through any desired angle. The driven chain sprocket is preferably friction driven so that the sprocket may slip on the shaft upon being overloaded.

By reason of the main lift cylinder being in several sections, the cradle 81 on the top of the main lift may be rotated manually on its vertical axis.

The hydraulic system by means of which the several units of the device are operated is best illustrated by the hydraulic flow diagram Fig. 10.

The tank 112 which is part of the right-hand side member 12 has a filler cap at 114. Four electrically operated pumps 116 draw hydraulic fluid from the tank 112 through a filter 118 and discharge it through check valves 120 into a manifold 122. A short conduit 124 connects the manifold 122 back to the tank 112 through a manually controlled relief valve 126. An accumulator 128 and a pressure actuated electric switch 130 are in pressure communication with the manifold 122. The accumulator 128 is of sufficient capacity to permit minor hydraulic shifts to be made after the pumps are shut off. The relief valve 126 is provided primarily to relieve back pressure when the pumps are being primed. The switch 130 is so adjusted that when the pressure in the manifold 122 exceeds a predetermined value the switch will momentarily discontinue operation of the electric pumps 116 starting them again when the pressure drops to or below the predetermined value. A high pressure supply line 132 extends from the manifold 122 to the high

pressure side of a pressure actuated relief valve 134, the low pressure side of the relief valve 134 being connected to the tank 112 by a low pressure return line 136. Relief valve 134 is installed at the end of the high pressure supply line principally to prevent too high pressure build-up in case the pressure actuated electric switch should malfunction.

At the forward end of the left side member 12 (see Fig. 1) is a control valve cabinet 138 which contains the control valves provided for directing the hydraulic fluid to the various motors and cylinders for performing the intended functions of the lift. The bodies of the valves are substantially alike each having four flow openings which, to facilitate description are numbered anticlockwise 1, 2, 3 and 4.

Referring now to the initial lift control mechanism, the initial lift control valve 140 has its flow opening 1 permanently in flow communication with the high pressure supply line 132, and its flow opening 3 permanently in communication with the low pressure return line 136.

When the initial lift control valve 140 is now operated to a position which places opening 1 in flow communication with 2, and opening 3 in flow communication with 4, high pressure fluid will be directed through initial lift supply pipe 142, through flow divider fluid motors 144, through pipes 146, 146', 146'', 146''' into the lower ends of initial lift cylinders 34. As the initial lift pistons 36 rise, the hydraulic fluid from the upper ends of the cylinders is forced upward through pipe 148 and across flow openings 4 and 3 of the initial lift control valve 140 back through low pressure return line 136 to the tank 112.

If the initial lift control valve 140 is next operated to a position which places opening 1 in flow communication with 4 and opening 3 in flow communication with 2, high pressure fluid will be directed through pipe 148 into the upper ends of initial lift cylinders 34, thereby forcing the initial lift pistons 36 downward and the fluid under the piston backward through pipes 146, 146', 146'' and 146''', flow divider motors 144, pipe 142, across flow openings 2 and 3 of the initial control valve 140 back through low pressure return line 136 to the tank. The four flow divider motors are geared together to insure equal flow to and from each of the initial lift cylinders 34 and therefore equal movement, up or down, of the initial lift pistons 36.

Referring now to the main lift mechanism, a main lift control valve 152 has its flow opening 1 permanently in communication with the high pressure supply line 132; and its flow opening 3 permanently in communication with the low pressure return line 136.

When the main lift control valve 152 is now operated to a position which places opening 1 in flow communication with opening 2, high pressure fluid will be directed through the main lift supply pipe 154, to the lower end of the main lift cylinder assembly 156 while if opening 2 is connected to 3 the weight of the cylinder assembly will force the fluid backwardly through pipe 154 to the low pressure return pipe 136 and back to the tank 112. A second main lift control valve 152' is provided and connected in parallel with the first merely to increase the flow capacity, both valves 152 and 152' being operated coincidentally by the same lever on the outside of the control valve cabinet 138 (see Figs. 1 and 4).

With respect to the mechanism for moving the main lift cylinder assembly 156 transversely of

the main lift carriage 48, a transverse adjustment valve 158 has flow openings 1 and 3 connected respectively to the high pressure supply line 132 and low pressure return line 136, while flow openings 2 and 4 are connected respectively to the front and rear transverse adjustment cylinders 70. Obviously if the mechanism of the control valve 158 connects flow openings 1 to 2 and 3 to 4, movement of the pistons will both be in one direction, while if it connects 1 to 4 and 2 to 3, the pistons will both move in the other direction. The space between the two transverse adjustment pistons 72 is closely taken up by the rectangular bar 73 against which the ends of the pistons 72 act.

For adjusting the main lift carriage axially, the two axial adjustment cylinders 74 are controlled by the axial adjustment valve 160. Valve 160 has flow openings 1 and 3 in flow communication with the high pressure supply line 132 and the low pressure return line 136, respectively, openings 2 and 4 being in flow communication with opposite ends of the axial adjustment cylinders 74. The valve 160 is operable to two positions one for joining flow openings 1 to 2 and 3 to 4 for coincidentally moving both pistons 76 axially in one direction and the other joining flow openings 1 to 4 and 2 to 3 for coincidentally moving both pistons 76 axially in the other direction.

A valve 162 controls the tilting of the cylinders 92 whereby the bomb may be tilted nose up or nose down as desired. The pistons 94 of opposite cylinders 92 are connected together to move as one. Flow passages 1 and 3 are in communication with the high and low pressure lines respectively and flow passages 2 and 4 are in communication as shown with the outer ends of cylinders 92. Setting the valve so that it will join flow passages 1 to 2 and 3 to 4, will move the pistons one direction while setting it to join 1 to 4 and 2 to 3 will move them in the other direction. Movement of the pistons acting on levers 98 will rock the convex ways 88 in the concave ways 86.

The roll motor 108, which is provided for rotating the bomb on its axis, is hydraulically operated and is controlled by the valve 164. Flow passages 1 and 3 are connected across the high and low pressure line while 2 and 4 are connected through the motor. Connection by the valve of 1 to 2 and 3 to 4 operates the motor in one direction while connecting 1 to 4 and 2 to 3 operates it in the other direction.

The operation of the lift is substantially as follows:

(1) The bomb is placed on the ground on clearance blocks two to three inches thick. (2) The truck is backed astride the bomb with the approximate center of gravity of the bomb centered over the four initial lift cylinders 34. (3) The initial lift beams 38 are placed atop the initial lift pistons 36. (4) The slings 40 are passed under the bomb and secured to the initial lift beams 38. (5) The initial lift control valve 140 is now manipulated to raise the bomb several feet from the ground. (6) If the bomb is to be transported on the truck before loading in an airplane, the transport beams 42 are laid with their ends on the rails 21 and the initial control valve 140 manipulated to lower the initial lifting beams 38 until the bomb rests on the transport beams 42. (7) The bomb is transported to the place of loading in the airplane. (8) The valve 140 is manipulated to raise the bomb off the trans-

port beams 42 and the transport beams 42 are removed. (9) The main lift 23 is rolled rearward on the rails 21 until its vertical axis is on the approximate center of gravity of the bomb.

(10) With the main lift control valve 152, the bomb is hoisted into the bomb bay, then the valves 160 and 158 are employed for making small axial or transverse adjustments, and the valves 162 and 164 are employed for tilting the bomb nose up or nose down and for rolling the bomb on its axis.

Having described an embodiment of my invention, I claim:

1. The combination, in a bomb lifting device of the character described, of a truck which includes a frame consisting of two elongated side members and a single cross member joining said side members at the forward end, a rear road wheel rotatably supported on the rear end of each side member, a front road wheel supported on said cross member mounted for rotation and for pivoting on a vertical axis, said rear road wheels and said side members being spaced slightly wider apart than the transverse measurement of the bomb which is to be lifted, whereby the truck may be backed over the bomb while said bomb is lying on the ground, lifting means for lifting said bomb off the ground carried in fixed position on said side members, and a second lifting means movable along said side members to a position under said bomb after it has been lifted off the ground by said first lifting means.

2. The device of claim 1 with rails extending along the inside of said side members and track wheels supporting said second bomb lifting means rollable on said rails whereby said second bomb lifting means may be rolled on said track under the center of gravity of said bomb.

3. The device of claim 2 with the initial lift consisting of four single lifts two fixed on each of said side members with two initial lifting beams joining opposite fixed lifts.

4. The lifting device defined in claim 1 wherein the said side members are tubular and are made in several separable lengths, flanges on the ends of said lengths joining the lengths together, and flanges on the forward ends of said side members and the ends of said cross member in a plane normal to the first said flanges joining said forward ends of said side members to said cross member, whereby the frame of said lifting device may be disassembled for transportation.

5. The device of claim 4 with discs clamped between spaced apart pairs of flanges to compose a hydraulic fluid storage tank between said spaced apart pairs.

6. The combination, in a bomb lifting device of a truck which includes a frame consisting of two elongated side members and a single cross member joining said side members at the forward end, a rear road wheel rotatably supported on the rear end of each side member, a front road wheel supported on said cross member mounted for rotation and for pivoting on a vertical axis, said rear road wheels and said side members being spaced slightly wider apart than the diameter of the bomb which is to be lifted, whereby the truck may be backed astride the bomb while said bomb is lying on the ground, rails secured along the

inner edge of said side members, an initial lifting device comprising opposite lifts fast on and extending upwardly from said side members outwardly beyond said rails, beam means extending transversely of the truck and resting on said lifts, means to attach said bomb to said beams to lift said bomb off the ground, a main bomb lift which includes a carriage roller-mounted on said rails whereby said main lift may be rolled along said rails and centered under said initial lift after said initial lift is raised, a bomb support in the form of a cradle at the upper end of said main lift, and hydraulic means to actuate said lifts.

7. The device defined in claim 6 wherein the main bomb lift includes means for adjusting the carriage along the rails, means for adjusting the left cylinders transversely of the carriage, means for rockably adjusting the bomb support for nose up or nose down of the bomb, and means for rotating the bomb on its axis.

8. The device defined in claim 7 wherein all mentioned means are hydraulic means.

9. The combination in a bomb lift of the character described of a pair of rails, a main lift consisting of a series of telescoping cylinders adapted to be controlled by a hydraulic fluid, a carriage movable on said rails in the direction of the bomb axis, cross slide means on the lower cylinder and said carriage for moving said lift transversely of the bomb axis, a bomb supporting cradle on the upper cylinder rockable in the plane of the bomb axis to move the bomb nose-up or nose-down, rectangularly spaced rollers on the four corners of the cradle having their axes parallel with the bomb axis and positioned to roller-support the bomb, and controllable power means to adjust said carriage along said rails, to adjust said main lift transversely of the bomb axis, to operate said lift, to rock said cradle and to rotatably adjust said bomb on its axis.

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