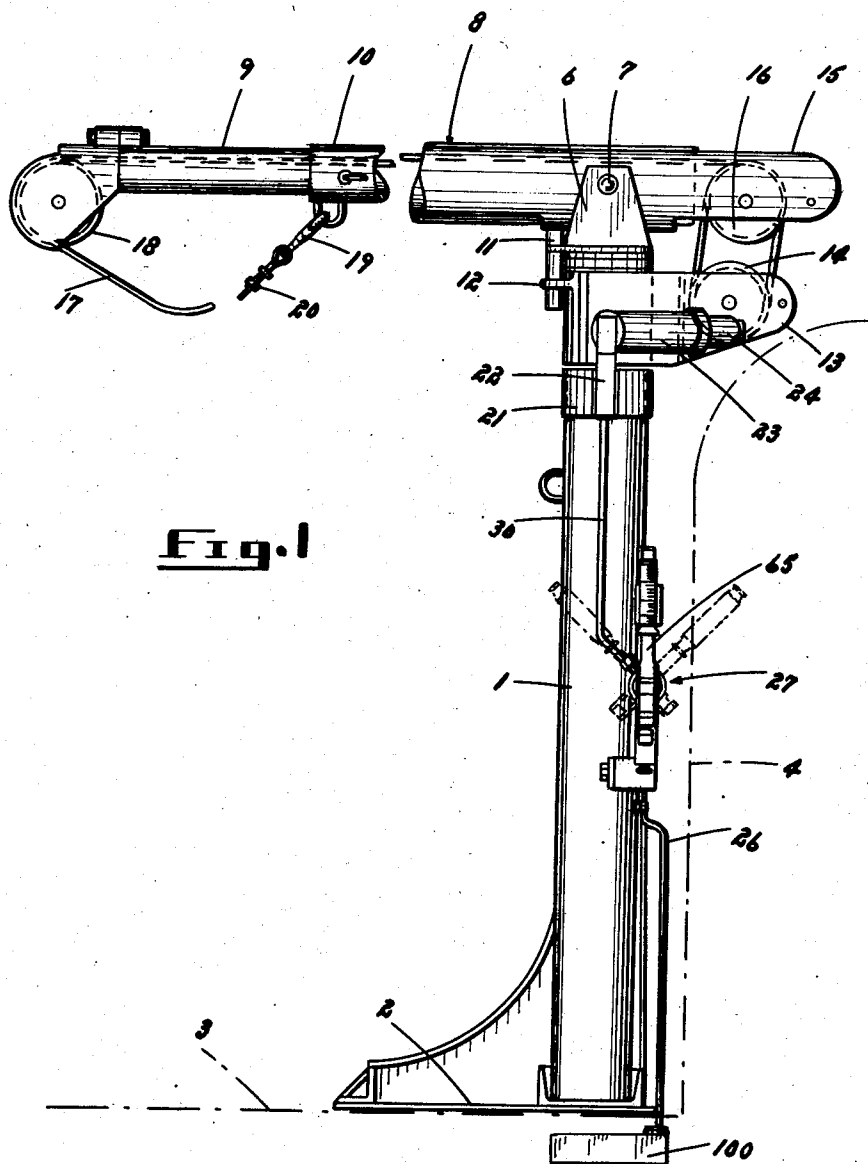


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HYDRAULIC JACK

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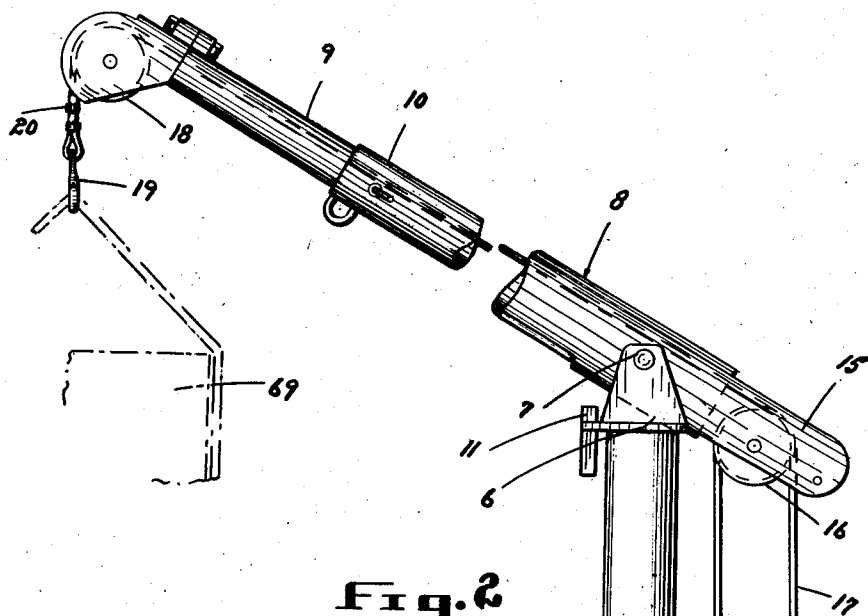


Fig. 2

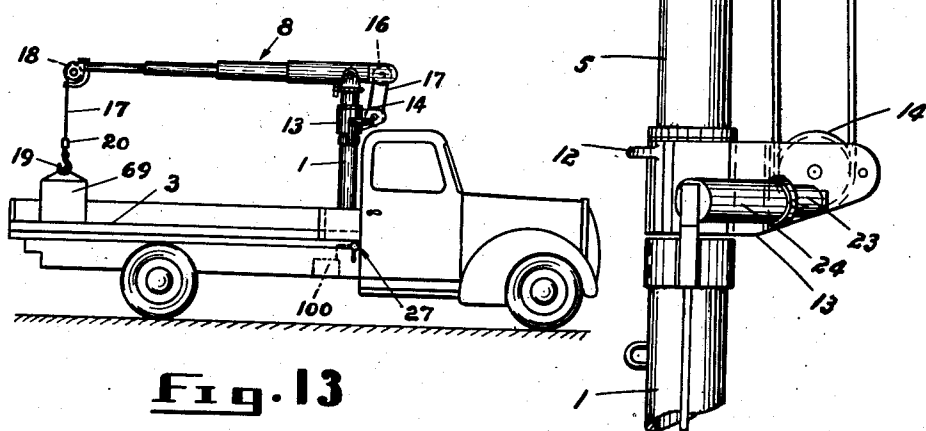


Fig. 13

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Fig. 3

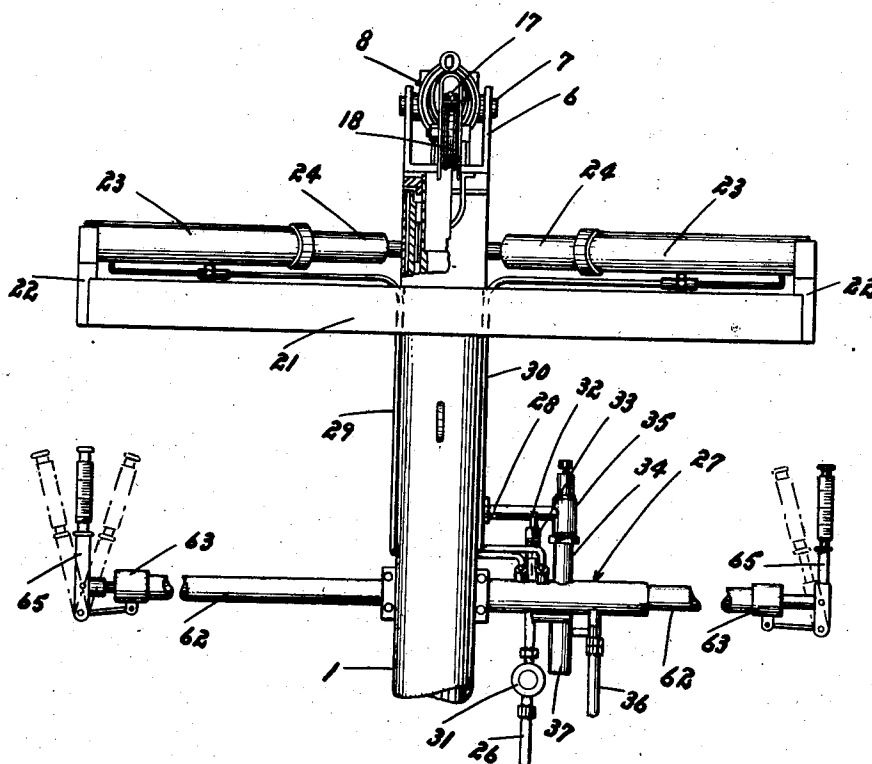
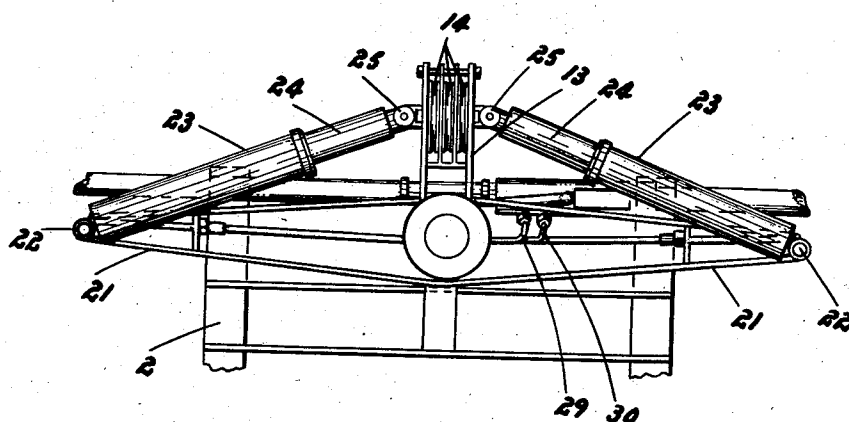


Fig. 4

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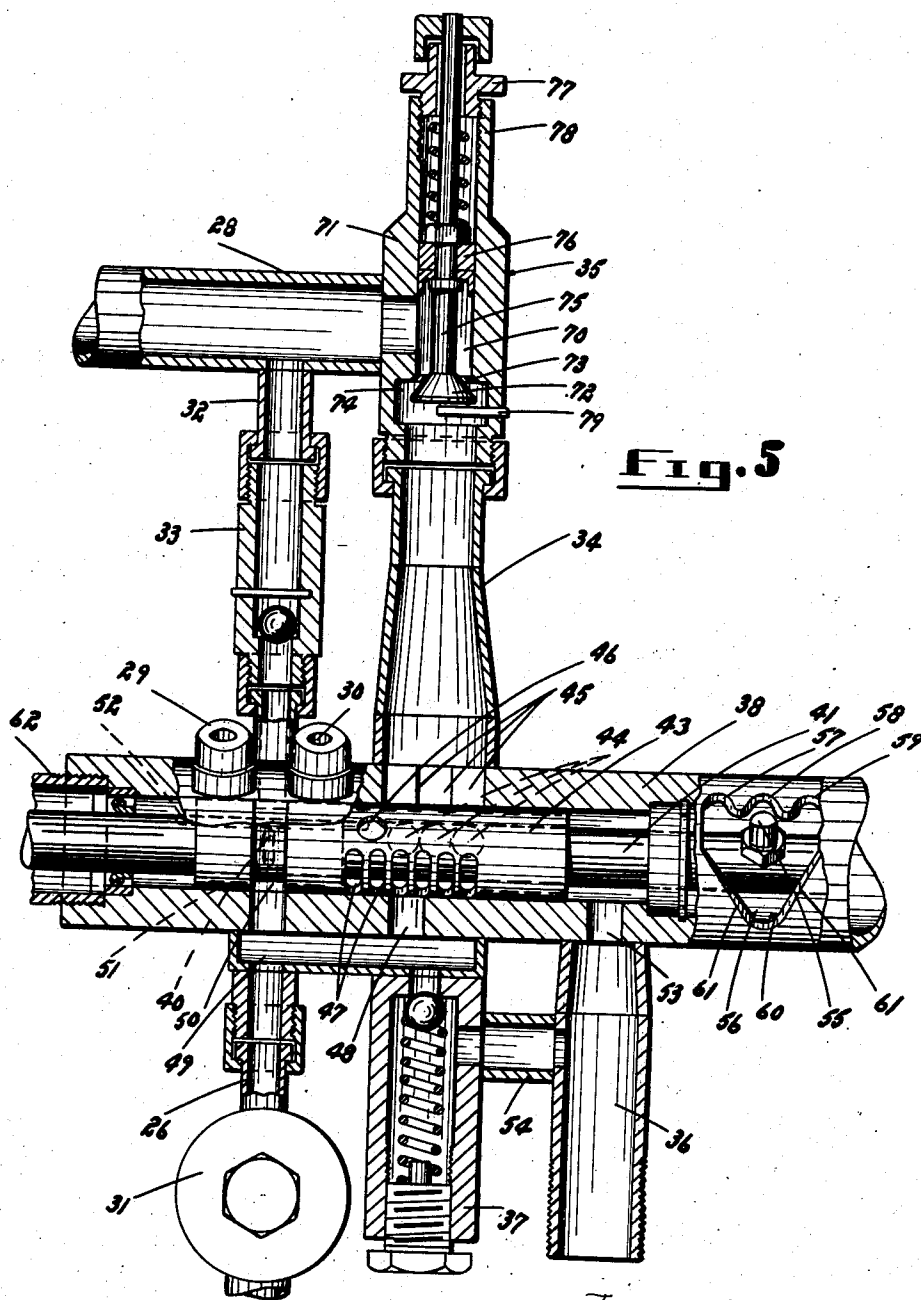
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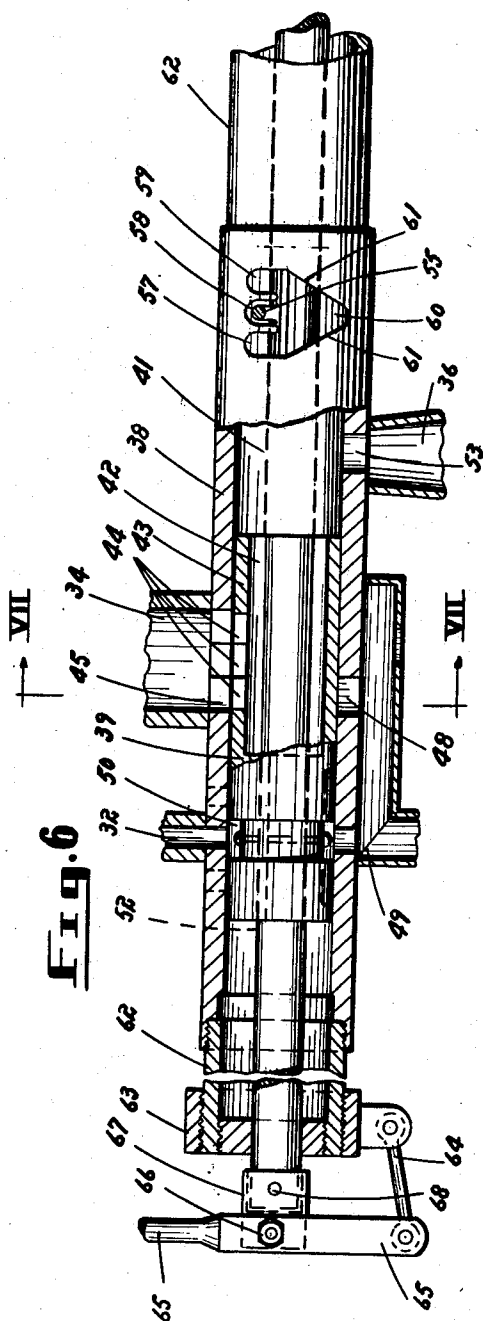


Fig. 6

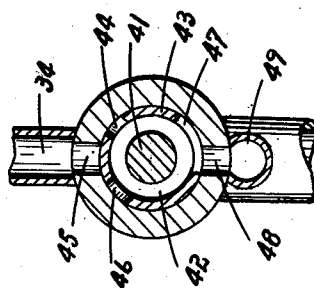


Fig. 8

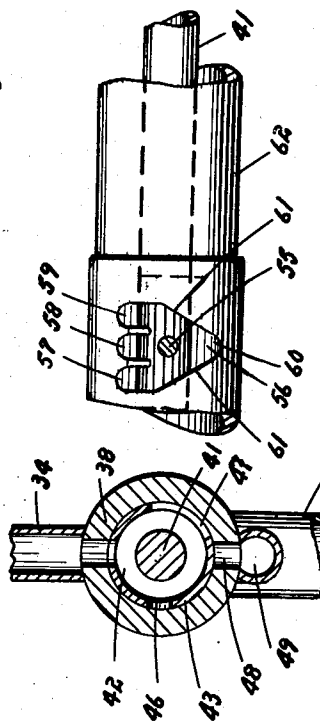


Fig. 9

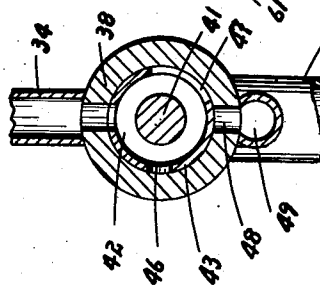


Fig. 7

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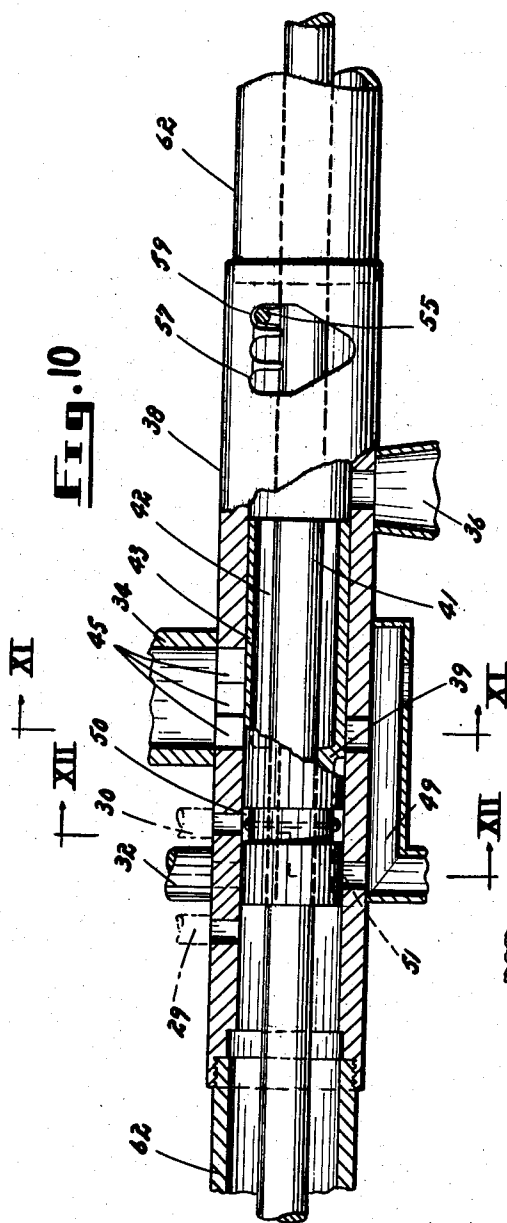
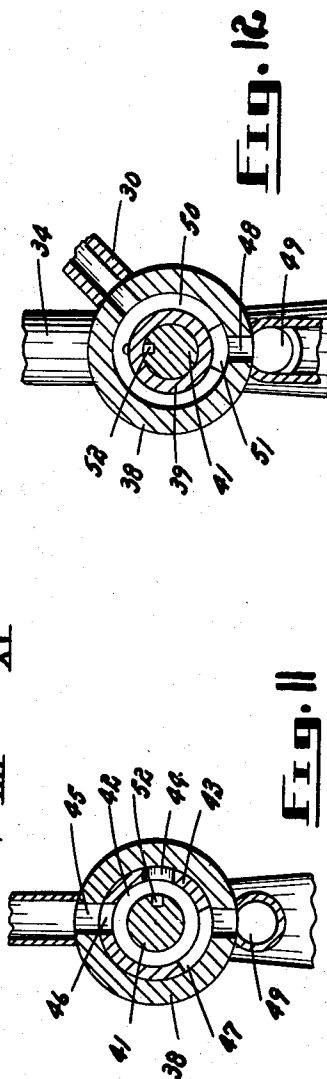
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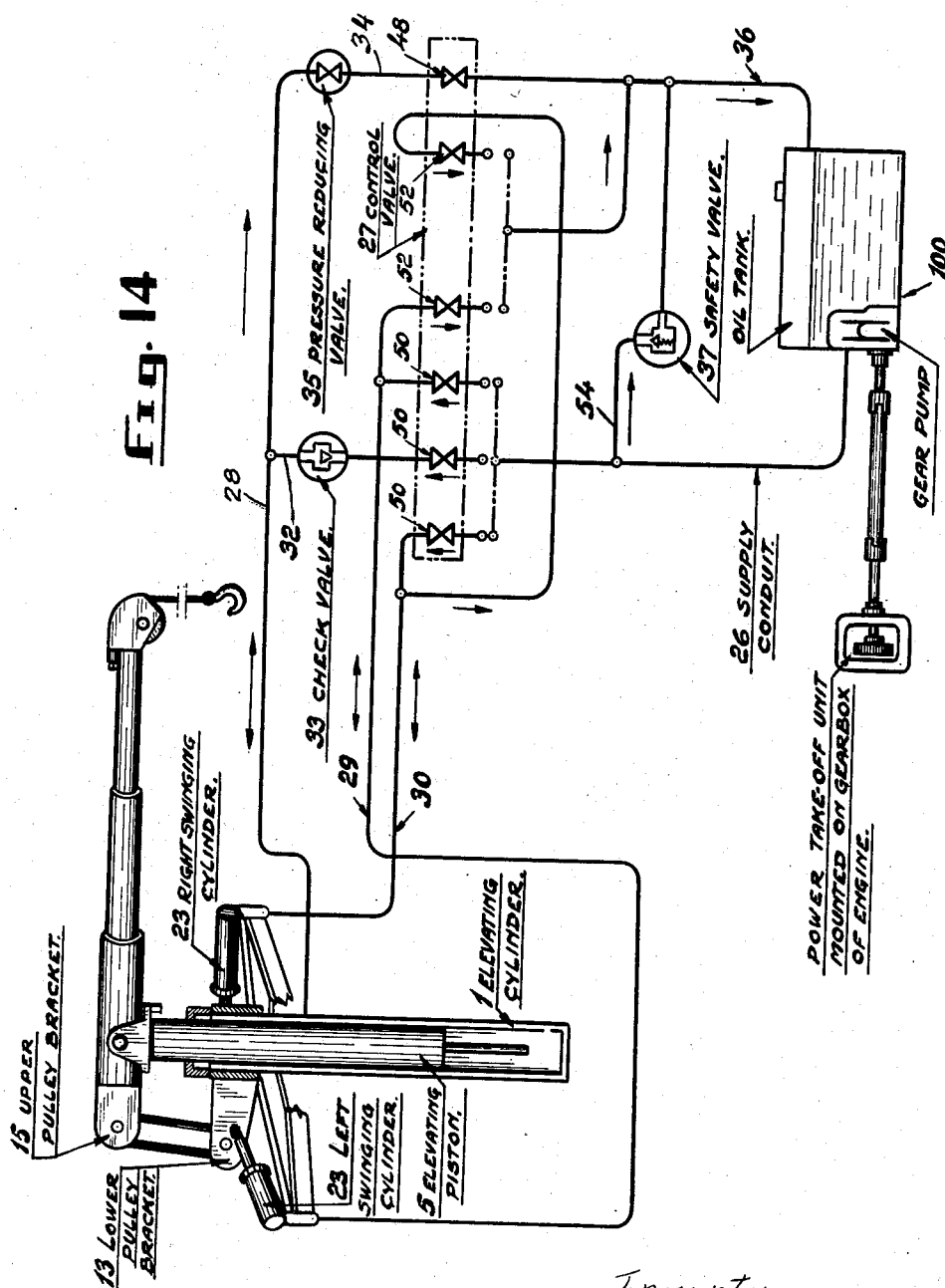
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UNITED STATES PATENT OFFICE

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HYDRAULIC JACK

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Application March 8, 1950, Serial No. 148,310

4 Claims. (Cl. 212—35)

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This invention relates to a hydraulic jack especially adapted to be mounted on self-propelled trucks or other vehicles or on vessels.

The invention provides a relatively cheap and extremely practical loading apparatus first of all for self-propelled trucks. The lever beam can be swung at right angles to the body of the truck and the load can be pulled up to the truck from a point at a considerable distance therefrom and then be lifted onto the body. The control device permits tilting and swinging of the lever beam in different planes in a convenient manner. The hydraulic jack may be raised to a substantial elevated height despite the fact that when the lever beam is in its lowermost position the jack does not extend, or extends but a short distance, above the driver's cabin of the truck. According to an embodiment of the invention the hydraulic jack also includes a pressure reducing valve which ensures that the speed of lowering the load does not exceed a certain determined limit.

More specifically, the invention comprises a hydraulic jack to be mounted on a vehicle having a hydraulic pump, an elevating cylinder for the vertical placement of the jack, a piston moving in the cylinder, a pump supplying the hydraulic fluid for the jack, a lever beam at the top of the piston having two arms of different length, a pulley and cable at the longer arm of the lever beam and a plurality of pulleys and cables at the shorter arm, several swinging cylinders and pistons connected with the pump to swing the lower pulleys and their support without the elevating cylinder and a control hydraulic device mounted for pivotal adjustment in the two vertical planes which are at right angles to each other for the control of the jack in these positions.

Other and further objects of the present invention will appear from the more detailed description set forth below, it being understood that such detailed description is given by way of illustration and explanation only and not by way of limitation, since various changes therein may be made by those skilled in the art without departing from the scope and spirit of the present invention.

The invention will be described more in detail in the following, reference being had to the accompanying drawings in which:

Fig. 1 is a side view of a hydraulic jack according to the invention, the lever beam being in its lowermost position.

Fig. 2 shows a similar view of the top end of the jack with the lever beam in tilted position,

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Fig. 3 is a front view of the top end of the jack with the lever beam in its lowermost position,

Fig. 4 is a plan view of the jack, the lever beam being omitted for the sake of clarity,

Fig. 5 is a vertical longitudinal section through the main parts of the control device of the jack,

Fig. 6 is a longitudinal section through the control valve included in the control device and adjusted for tilting the lever beam,

Fig. 7 is a cross section on line VII—VII of Fig. 6,

Fig. 8 is a similar cross section, the control valve occupying however an intermediary position,

Fig. 9 is a side view of a connecting means arranged at the right end (as viewed in Fig. 6) of the control valve, said valve occupying the position shown in Fig. 8,

Fig. 10 shows a longitudinal section similar to

Fig. 6, the control valve occupying however the position for swinging the lever beam in one direction in a horizontal plane,

Fig. 11 is a cross section on line XI—XI of Fig. 10,

Fig. 12 is a cross section on line XII—XII of Fig. 10,

Fig. 13 is a side view of a vehicle with a hydraulic jack according to the present invention, and

Fig. 14 is a schematic diagram of the fluid system.

The elevating cylinder 1 of the hydraulic jack projects vertically from a base plate 2 which is mounted on the chassis frame 3 of a self-propelled truck behind the driver's cabin 4 of the latter. The chassis frame and the driver's cabin are shown by dash and dot lines. Vertically movable in the elevating cylinder 1 is a piston 5, the upper end of which is shaped like a fork 6 with a transverse axle 7 about which a lever beam 8 is mounted for pivotal movement in a vertical plane. Said lever beam has arms of different lengths and its long arm which comprises telescopically interengaging movable tubes 9, 10, is applied in its lowermost position against a stop 11 at the top end of the piston 5. In the lowermost position of the piston 5 the lever beam 8 is retained in the horizontal position by the lower portion of the stop 11 being introduced between two rearwardly extending pins 12 which are secured to a bracket 13, which bracket supports a number of pulleys 14 rotatably mounted at the outer end thereof. Said bracket 13 is pivotally mounted at the top end of the elevating cylinder 1. Rotatably mounted on the short arm 15 of the lever

beam are a corresponding number of pulleys 16. A steel cable or the like 17 is passed around said pulleys 14, 16 and has one end thereof secured either to the pulley bracket 13 or to the arm 15. Further, said cable is passed around a pulley 18 rotatably mounted at the outer end of the long lever beam arm. A lifting hook 19 or other lifting means is attached to this end of the cable 17. The cable may also be provided with an abutment 20 which is adjustable on the cable at various distances from the hook 19. The length of the cable 17 is so adapted to the length of stroke of the piston 5 and to the number of pulleys 14 and 16 on the bracket 13 and the lever arm 15 so that when the hook 19 or the abutment 20 abuts against the outer end of the long lever arm or a stop thereon, said piston has not made its full stroke but is able to move a further distance upwardly. At the end of the upward movement of the piston 5, the lever beam 8 is thereby caused to swing clockwise from the horizontal position shown in Fig. 1 to the upwardly inclined position according to Fig. 2.

At the upper end of the elevating cylinder 1 there is mounted a transverse yoke 21 which is provided at its two outer ends, which extend approximately equally far on both sides of the cylinder 1, with vertically upstanding pivot pins 22. Swingably mounted with their one ends on said pins are two cylinders 23 which are adapted to swing the lever beam 8 in a horizontal plane and which will be called "swinging cylinders" in the following. Pistons 24 are axially movable in the cylinders 23 and are each hingedly connected by means of a pin 25 to the pulley bracket 13.

A hydraulic pump 100 (schematically shown in Fig. 1) which is mounted on the truck is driven by the truck engine and pumps oil from an oil supply through a supply conduit 26 to the control valve 27 included in the control device. Said control valve is connected by a conduit 28 to the elevating cylinder 1 below the piston 5 and furthermore it is connected to the two swinging cylinders 23 by two conduits 29 and 30. An oil filter 31 (Fig. 3) is inserted in the supply conduit 26. A conduit 32 leading from the control valve 27 emerges in the conduit 28 and a check valve 33 is inserted in the conduit 32, permitting the oil to flow from the control valve through conduit 32 into conduit 28 but not in the reverse direction. The conduit 28 is connected by a conduit 34 through a reduction valve 35 to the control valve 27. The latter valve 27 is connected to return conduit 36 and to the inlet of the pump or to the oil container situated there. A safety valve 37 is mounted on the lower side of the control valve 27 and is operative when the oil pressure in the supply conduit 26 rises over a predetermined value.

Rotatably and axially movable in the valve housing 38 of the control valve 27 (see Figs. 5 to 12) is a valve body 39 which comprises a sleeve fixed to a control rod 41 axially extending through the valve housing by means of a pin 40, the cylinder wall of which sleeve is considerably thinner in one end portion (the right end portion according to the drawings) than in the other (left) end portion so that there is formed a free annular space 42 between the control rod 41 and said thinner cylinder wall 43. A row of three ports 44 are provided in the cylinder wall 43 and by rotation of the valve body 39 said ports can be brought to register with three corresponding ports 45 in the valve housing 38. The latter ports are situated at the lower end of conduit 34.

There is a fourth port 46 in the valve body which may be brought to register with the mouth of conduit 30. Furthermore, a row of six ports 47 are provided in the cylinder wall 43 and at a certain angular position of the valve body 39 these ports connect the space 42 over an opening 48 in the valve housing 38 with a chamber 49 in which the supply conduit 26 emerges. The left (thicker) portion of the valve body 39 is provided with a peripheral groove 50 from which an axial groove 51 extends towards both sides. Said groove 51 is provided in the mantle surface of the valve body. The control rod 41 has an axial groove 52 for return oil from the conduit 29 leading from the left swinging cylinder 23 (as viewed in Figs. 3, 4) to the space 42. The latter is in communication with the main return conduit 36 through a port 53 in the valve housing 38. The safety valve 37 is inserted in the conduit 54 leading from chamber 49 to the main return conduit 36.

The control rod 41 has a radially extending coupling bolt 55 provided with a surrounding, easily rotatable sleeve. By axially displacing and rotating the control rod said bolt may be moved within a substantially V-shaped opening 56 in the valve housing 38. At its upper portion the opening 56 is formed with three coupling notches 57, 58 and 59 and at its lower portion there is a further coupling notch 60. The surfaces 61 extending obliquely upwards from the last-mentioned coupling notch 60 serve the purpose of guiding the bolt 55 and thus the control rod 41 when the control valve is acted upon.

The control rod 41 extends to both sides of the valve housing 38 and is surrounded by tubes 62 fixed with their one ends to the ends of the valve housing 38. The tubes 62 are of such a length as to reach somewhat outside the lateral edges of the truck body. Rotatably mounted on each of the outer ends of said tubes is a sleeve 63 to which a link 64 has its one end hingedly attached, while its other end is hingedly attached to one end of a two-armed control lever 65 which is pivotally mounted about a bolt 66 on the outer end of the sleeve 67. Said sleeve is secured to the respective outer end of the control rod 41 by means of a pin (fraction pin) 68. This arrangement permits axial displacement of the control rod and the valve body 39 by means of the control lever 65 and adjustment of the valve body in its various angular positions.

When the control valve is in zero position (Figs. 5, 8 and 9) in which the coupling bolt 55 is situated approximately midway between the coupling notches 58 and 60, oil is pumped from the pump through conduit 26, chamber 49, port 48 in valve housing 38 and ports 47 in valve body 39, through space 42, opening 53 in the valve housing and the return conduit 36 to the oil container. When the control rod 41 and thus the valve body 39 are rotated into such a position that the coupling bolt 55 is introduced into notch 58 (Fig. 6) oil flows under pressure from chamber 49 through the peripheral groove 50 and over the check valve 33 and conduits 32 and 28 into the elevating cylinder 1. The port 48 in the valve housing is then closed by the cylinder wall 43 (Figs. 6 and 7). When oil flows into the elevating cylinder 1 the piston 5 is pressed upwardly, the cable 17 running to the right (as viewed in Fig. 2) over the idling pulley 18, whereby a load 69 suspended from the hook 19 is elevated to the necessary height over the body 3. If the load 69 must be lifted especially high, the piston 5 is permitted to move upwards also after the abut-

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ment 20 or the hook 19 has been applied against the outer end of the long lever arm.

The lever beam 8 is then swung clockwise about axle 7. After the load has reached the desired height (in the case where the load is to be unloaded from the truck body), the control lever 65 is so swung that the bolt 55 is situated in zero position (Fig. 9) when the valve body 39 occupies Fig. 8 position. Then the oil flow into the elevating cylinder 1 ceases and since the cylinder wall 43 in this position closes the ports 45 in the valve housing and the check valve 33 only permits flow in an upward direction through conduit 32, oil is prevented from being driven back out of the lifting cylinder 1, for which reason the load 69 remains in elevated position. When the coupling lever 65 is swung in such a direction in a plane coinciding with the control rod 41, that the bolt 55 abuts against the right side surface of opening 53 and the control rod 41 with the coupling lever is then rotated until the bolt 55 engages with the right-hand notch 59, the valve body 39 occupies the position shown in Figs. 10 and 11. The oil is then squeezed from chamber 49 into the left end of the axial groove 51 and through the peripheral groove 50 and the conduit 30 into the right-hand swinging cylinder 23 (Fig. 4). The piston 24 of said swinging cylinder is thereby pressed to the left, which involves that the pulley bracket 13 is swung counter-clockwise. The runs of the cable 17 situated between pulleys 14 to 16 will thereby be inclined, the pull in these cable runs involving that the lever beam 8 is also swung counter-clockwise according to Fig. 4, whereby the load is moved out from the body of the car.

When the piston of the right-hand swinging cylinder 23 is pressed to the left, the piston of the left-hand swinging cylinder 23 is urged into this cylinder, the oil situated therein being pressed through conduit 29 and over the bypass channel 52 of the control rod 41 into the space 42 and through the return conduit 36 back to the oil container. Should the lever beam 8 be swung in the opposite direction, it would be necessary to move and to turn the valve body 39 into a position in which the bolt 55 engages the left coupling notch 57, the peripheral groove 50 in valve body 39 registering with the conduit 29 leading to the left-hand swinging cylinder 23 (Fig. 4). In this position of the valve body 39 the port 46 is opposite the point where the conduit 30 from the right-hand swinging cylinder 23 emerges into the valve housing 38, so that the oil in this cylinder may be returned to the oil container through the space 42 and the conduit 36. When the control lever 65 is then so swung that the bolt 55 is sliding against either of the guiding surfaces 61 of the opening 56 leading to the lower coupling notch 60, the valve body 39 occupies a position in which the inlet from chamber 49 to conduits 29, 30 and 32 is cut off, but the connection between chamber 49 and the return conduit 36 is open through port 48 in the valve housing 38 and the ports 47 in the valve body 39 as well as through the space 42 and the opening 53. The ports 44 in the valve body 39 register with the openings 45 in the valve housing 38. Thus, elevating cylinder 1, conduit 28, reduction valve 35, conduit 34, openings 45 and ports 44, space 42, return conduit 36 and oil container are in communication. By the weight of the piston 5, the lever beam 8 and the load 69 the oil is pressed out of the lifting cylinder 1 back to the oil container and the load is lowered.

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If special steps are not taken, a heavier load 69 would be lowered more rapidly than a lighter one, for the return flow of the oil would of course take place more rapidly than at a lighter load due to the higher pressure. However, the use of the pressure reducing valve 25 results in the lowering of the load taking place at approximately the same speed either the load is heavy or light. Axially movable in bore 70 in the valve housing 71 of the pressure reducing valve is a conical valve body 72 disposed to provide an annular space 74 between itself and a seat 73 in the valve housing, when the valve is open. A piston 76 movable in the bore 70 is attached to the valve stem 75. A screw spring 78 is clamped between a screw nipple 77 at one end of the valve housing 71 and the piston 76, the nipple 77 enabling adjustment of the tension of said spring. The movements of the valve body 72 are limited by a stop pin 79. When on lowering the load the oil pressure is suitable for normal lowering speed the valve body 72 occupies approximately the position shown in Fig. 5. An increase of the oil pressure results in the valve body 72 being pressed towards the seat 73 by the action of spring 78 due to the fact that the valve body has a larger operative end surface than piston 76. The through-flow section of space 74 is thus decreased. However, since the speed of the flowing liquid increases on account of the pressure increase and substantially the same amount of liquid under pressure will flow through the valve per unit of time before as after said increase. This means that the speed at which the load is lowered remains approximately the same either the load is heavy or light.

It is thought that the invention and its advantages will be understood from the foregoing description and it is apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing its material advantages; the form hereinbefore described and illustrated in the drawings being merely a preferred embodiment thereof.

What I claim is:

1. A hydraulic jack adapted to be mounted on vehicles or vessels, comprising in combination a hydraulic pump mounted on the vehicle, an elevating cylinder vertically mounted on the vehicle, a piston movable up and down in said cylinder, a conduit connecting said cylinder to said pump to force pressure liquid to the lower part of the cylinder, a lever beam supported on the top end of said piston and having two arms of different lengths, a pulley at the outer end of the longer of said arms, a cable over said pulley, a lifting implement at the outer end of said cable, a bracket and a plurality of pulleys on the outer end of the shorter arm for the same cable, a plurality of similar pulleys corresponding to the number of pulleys of the shorter arm, a pulley bracket mounting said pulleys supported by the elevating cylinder and mounted for swinging movement in a horizontal plane, said cable being passed around said pulleys, said cable being attached at its free end to one of said two pulley brackets, two swinging cylinders connected with the pump, pistons movable in said cylinders for swinging the lower pulley bracket about the elevating cylinder in one or the other direction, a control device inserted in said conduit between said pump and the elevating and the swinging cylinders, a control valve in said device adapted to lead liquid under pressure optionally to the

elevating cylinder or to any one of the swinging cylinders by adjustment into different positions, a valve body for said control valve and a valve housing therefor, said valve body being rotatable and axially displaceable in said valve housing, a control lever, a control rod connecting said control lever to said valve body, said control lever being mounted for pivotal adjustment in two vertical planes which are at right angles to each other.

2. A hydraulic jack as claimed in claim 1, said lever beam being pivotally mounted on the upper end of said piston, a stop member on the outer end of said cable, a stop on the long arm of said lever beam, the length of the cable passed around the pulleys of the pulley brackets and the pulley mounted on the long arm of the lever beam being adapted to the length of stroke of the piston and to the number of pulleys on the short arm of the lever beam and on the lower pulley bracket whereby when said stop member on the outer end of the cable abuts against said stop on the long lever beam arm, said piston has not performed its full stroke but can move a further distance upwards in order to tilt the long arm of the lever beam upwardly.

3. A hydraulic jack as claimed in claim 2, a substantially V-shaped opening provided in the cylindrical wall of said valve housing, the upper edge portion of said opening having three coupling notches of substantially the same size also provided in the wall, a coupling bolt and an easily rotatable sleeve therearound mounted on said control rod, said notches being arranged for said coupling bolt and said surrounding sleeve, said valve body and said casing having openings and channels therein, the valve body being so arranged that by means of said openings and channels in said body, cooperating with corresponding said openings and channels in the valve housing, said valve body can lead liquid under pressure to the elevating cylinder when the valve body has been turned through a distance in one direction and the coupling bolt inserted in the middle one of the three coupling notches but cutting off the pressure liquid from the elevating cylinder when the valve body has been turned through a distance in the opposite direction and the coupling bolt occupies a position midway between the intermediary notch and the coupling notch arranged at the bottom of the V-shaped opening,

and the pressure liquid being discharged from the lifting cylinder when the valve body has been turned through a distance and the bolt engages with the lower coupling notch and the valve body leading the liquid under pressure to either of the swinging cylinders for swinging the lever beam in a horizontal plane when the bolt, after the control rod has been axially displaced in either direction, engages with either of the two outermost notches, but the pressure liquid being cut off from these piston cylinders when the control rod and the valve body have been turned through a distance whereby the bolt occupies a position midway between one of these outermost notches and the lower coupling notch.

4. A hydraulic jack according to claim 3, the valve body comprising a cylindrical metal sleeve passed onto the control rod and fixedly connected thereto by means extending through diametrical holes in the valve body and the rod, the cylinder wall of said metal sleeve being considerably thinner in one end portion than in the other one so that a free annular space is formed between the control rod and the thinner cylinder wall, and the other end portion of the valve body having a thicker cylinder wall, being provided with an outer peripheral groove situated approximately at the middle of the valve body, which groove is so arranged that when the valve body is displaced and rotated it can open or break the connections between the channels of the valve housing and the valve body for permitting the liquid under pressure to flow into the elevating cylinder and into the swinging cylinders, respectively, and the thinner cylinder wall of the valve body having ports cooperating with corresponding ports in the valve housing and so arranged that the pressure liquid from the elevating cylinder and the swinging cylinders can be cut off and discharged, respectively, from the discharge conduit of the valve in accordance with the angular or axial position of the valve body in relation to the valve housing.

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