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HYDRAULIC JACK

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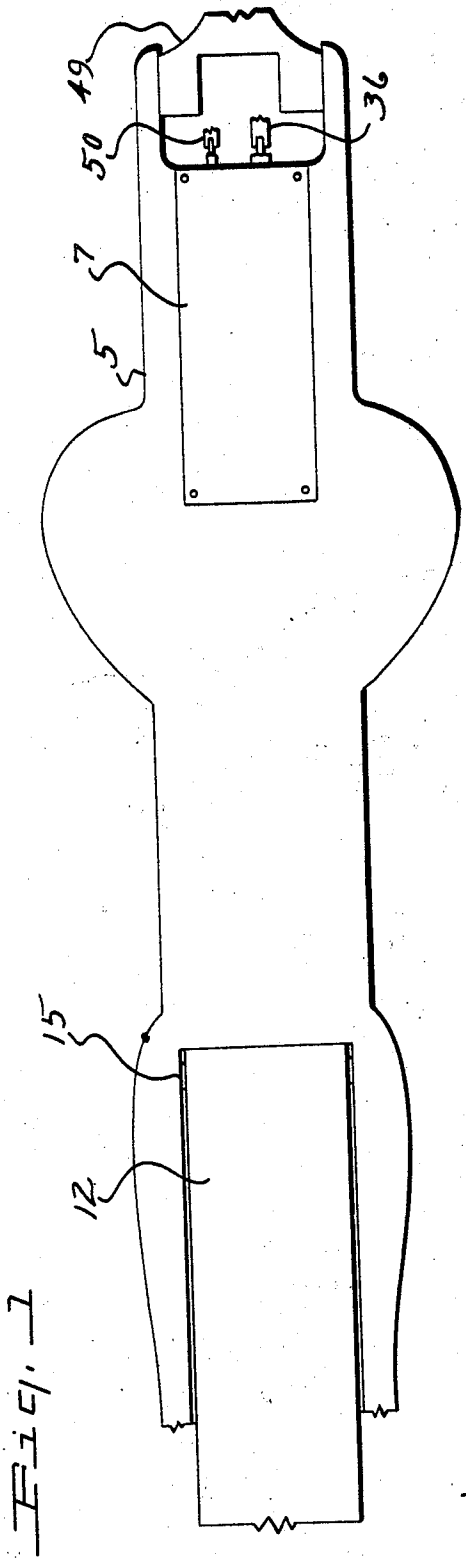


Fig. 1

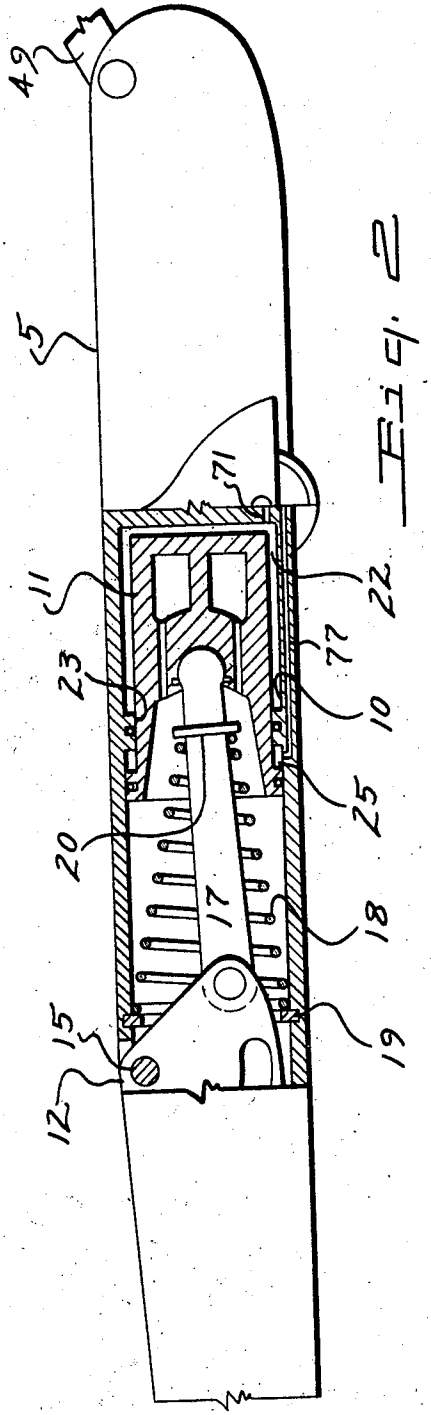


Fig. 2

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HYDRAULIC JACK

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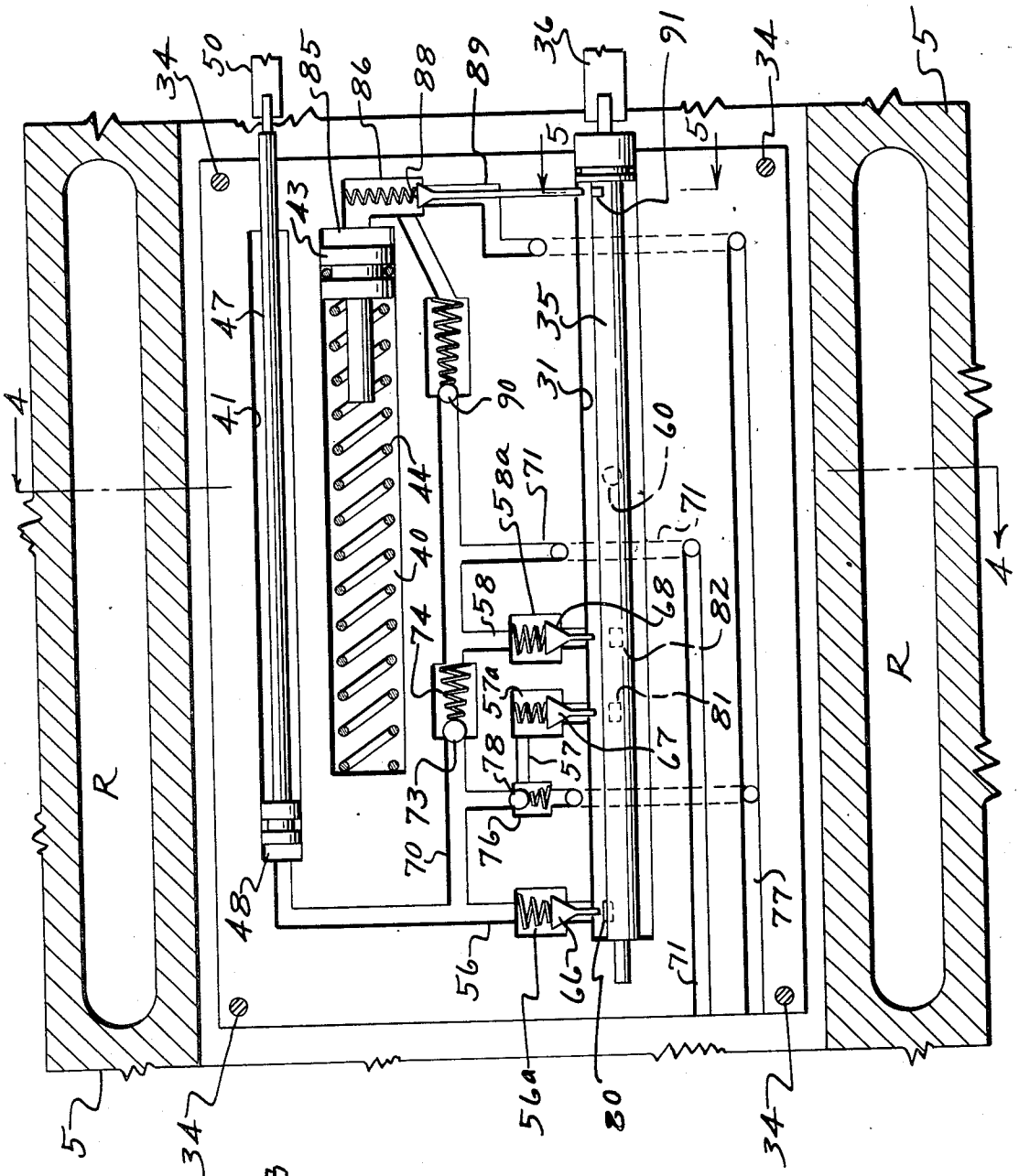


Fig. 3

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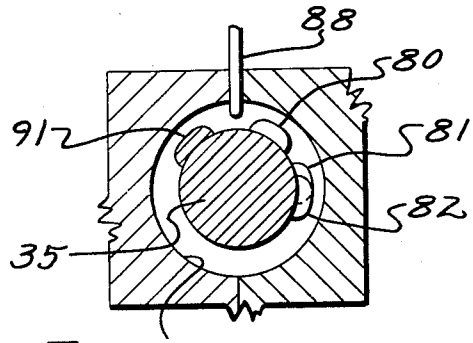


Fig. 5

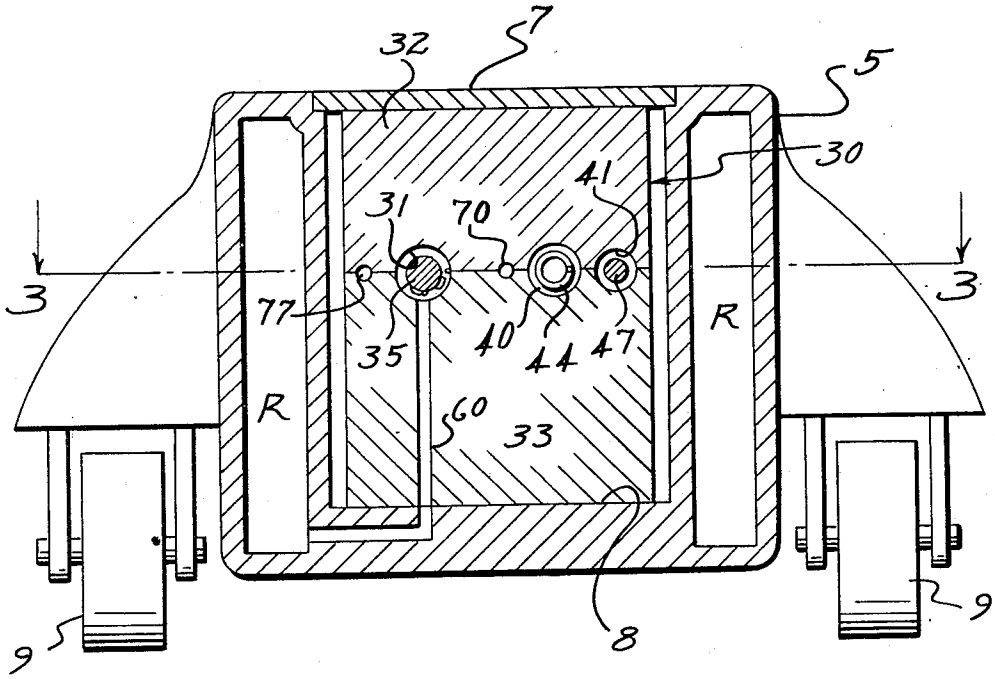


Fig. 9

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HYDRAULIC JACK

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Application August 21, 1944, Serial No. 550,332

7 Claims. (Cl. 254—8)

This invention has to do with hydraulic apparatus, such as jacks, employing a lifting arm to be initially moved into contact with work to be lifted and, after the work is thus contacted, to be thereafter moved by hydraulic action at a relatively different pressure-volume ratio.

In some respects my present invention is in the nature of an improvement upon the subject matter disclosed in my copending application Serial No. 527,199, filed March 20, 1944, and has for its primary object the provision of novel hydraulic means in such apparatus for automatically moving the work-lifting arm into initial contact with the work or load by virtue of energy stored in the device during a preceding work-lifting operation.

Another object of the invention is the provision in such a device of means for automatically lowering the lifting arm.

The invention also has as an object the provision of hydraulic jack construction wherein a hydraulic unit is incorporated in a block which may be readily removed and replaced in the body of the jack.

Additional and subordinate objects of the invention will appear from the following description of one embodiment thereof, for which purpose reference will be made to the accompanying drawings, in which:

Fig. 1 is a top plan view;

Fig. 2 is a side elevation partly in longitudinal section;

Fig. 3 is an enlarged section on line 3—3 of Fig. 4;

Fig. 4 is an enlarged section on line 4—4 of Fig. 3; and

Fig. 5 is an enlarged fragmentary section on line 5—5 of Fig. 3.

Although I show in the drawings and will now describe only one specific embodiment of the invention, it will be understood that within its broader aspects as defined by the accompanying claims the invention is susceptible of being embodied in other forms of apparatus differing specifically from the structure now to be described.

In general, I accomplish the aims of my invention by providing a surge chamber—that is, a chamber in which fluid is maintained under pressure by a spring-loaded plunger—in which chamber fluid pressure is built up and stored. Then, when it is desired to cause the lifting arm of the jack rapidly to be moved into initial contact with the work, a valve, controlling communication between the surge chamber and a relatively small annular pressure chamber around the work piston, is opened to cause communication of the surge chamber pressure to the annular chamber.

In the drawings, I show a body 5 having a receptacle 8 for the hydraulic unit to be described, and providing a fluid reservoir R. The cover cap 7 for the receptacle 8 is readily removable to provide access to the receptacle. The body is mounted on wheels 9.

The outer or left-hand end of the body provides a cylinder 10 within which a hollow piston 11 is mounted to reciprocate, and in the outer end of the body a lifting arm 12 of conventional construction is pivotally mounted by means of cross pin 15. A connecting rod 17 is pivotally mounted at its inner end in the piston and is pivotally connected at its outer end to the arm 12. To normally urge the piston inwardly of the cylinder, so as to automatically return the piston fully inwardly of the cylinder after the arm ceases to be lowered under influence of a lowered load, I provide a compression spring 18, which bears at its outer end against a snap ring 19 and at its inner end against an annular flange 20 on the connecting rod.

The inner end of the piston forms with the inner end of the cylinder a main pressure chamber 22, and the smaller diameter outer portion 23 of the cylinder forms with the larger diameter portion of the piston an annular auxiliary pressure chamber 25 of less area than the main chamber 22 for the purpose of receiving pressure to relatively quickly move the piston outwardly to effect initial contact of the lifting arm with the work to be lifted.

Within the receptacle 8 I mount a hydraulic unit 30 comprised of two companion blocks 32, 33 secured together by screws 34. A longitudinal bore 31 in or between blocks 33 has rotatably mounted therein a cam shaft 35 whose outer end projects from the bore and has pivotally connected thereto an actuating link 36. A longitudinal bore in the blocks provides a surge chamber 40, and a second bore provides a pumping cylinder 41.

To simplify explanation, I show the various bores above-mentioned as formed half in one of the blocks and half in the other block and mounted in mating relationship. Conventional gaskets or seal members, not shown, may be interposed between the blocks 32, 33 to prevent leakage of fluid from the several bores and passageways. It will be understood, of course, that each bore may be formed in either one of the blocks.

A pumping piston 47 reciprocates in cylinder

41 and its inner end forms with the inner end of the latter cylinder a pressure-generating chamber 48. Piston 47 is reciprocated by means of an actuating lever 49 pivotally connected to the outer end of the piston by link 50.

Formed half in block 32 and half in block 33 there are three passageways 56, 57, 58, each of which presents a valve chamber 56a, 57a, 58a. Spring-loaded check valves 66, 67, 68 seat in the chambers towards the reservoir R.

It will be observed that each of the passageways 56—58 communicates with bore 31 and in turn with the reservoir through a port 60 formed in block 33 and body 5.

Passageway 56 communicates with chamber 48 and with a passageway 70, which latter passageway communicates with the main pressure chamber 22 through a branch passageway 71. There is in passageway 70 between passageways 56 and 71 a ball check valve 73 which is urged seated towards chamber 48 by a relatively heavy compression spring 74 strong enough to maintain the valve seated until a predetermined pressure in chamber 48 greater than required to lift arm 12 into contact with the work is reached. Passageway 70, behind valve 73, also communicates with the reservoir through passageway 58 for pressure release purposes as will be described.

Passageway 70, at a point ahead of valve 73, communicates with a passageway 76, which latter in turn communicates with a passageway 77 leading to the auxiliary chamber 25, passageway 76 being controlled by a spring-loaded check valve 78 seating towards chamber 48.

Each of the check valves 66—68 has a stem which projects into the bore 31 to be selectively engaged by cams 80, 81, 82 upon rotation of the cam shaft 35, as will be hereinafter described, in order to unseat the valves against the pressure of their spring loads.

A plunger 43, loaded by compression spring 44, forms with the right-hand end of the surge chamber a pressure chamber 85 which is in constant communication with a valve chamber 86, the latter chamber communicating with passageway 70 to receive a charge of fluid. Between valve 73 and chamber 86, passageway 70 presents a spring-loaded check valve 90 seating away from the chamber 86. The outlet 89 from chamber 86 is controlled by a spring-loaded check valve 88 which seats away from the surge chamber. Outlet 89 communicates with passageway 77 and, through that passageway, with chamber 25.

In operation the parts cooperate and function as follows:

With the parts in the position shown, with the surge chamber not charged with fluid under pressure, reciprocation of piston 47 will, on each suction stroke, draw fluid from the reservoir through port 60, bore 31 and passage 45, past check valve 66 and on the first pressure stroke or two will force fluid into the auxiliary chamber 25 through ports 70, 76 and 77, past check valve 78, to raise the lifting arm 12 into contact with the load to be lifted. Chamber 25 being relatively small, this initial movement will take place relatively rapidly. During the initial movement of the arm 12 and the accompanying outward movement of piston 11, no fluid will pass valve 73 due to the relatively great pressure of spring 74, but as the piston 11 initially moves outwardly under the influence of pressure in chamber 25, fluid will be drawn into chamber 22 through ports 71 and 58.

After the lifting arm 12 contacts the load, the resistance to movement is, of course, greater so that on each subsequent pressure stroke of piston 47, valve 73 will be unseated against the pressure of spring 74 and fluid will be forced into chamber 25 through port 70 and at the same time pressure will be stored in the surge chamber 40 by virtue of that chamber being in communication with passageway 70 controlled by check valve 90. Thus the fluid under pressure entering chamber 40 will move the plunger 43 to the left, compressing spring 44, which pressure is retained by valves 90 and 88. After chamber 40 becomes thus initially charged, the piston 11 may be moved outwardly to initially bring the arm 12 into contact with the load during subsequent operation, by releasing the pressure in chamber 40 to the chamber 25 as will be described.

When the load is raised, the pumping lever 49 may be freed so that the hydraulic unit will not be affected by further operation of the lever. This is accomplished by rotating the cam shaft 35 counterclockwise until cam 80 unseats valve 66, which places chamber 48 in communication with the reservoir.

To lower the load, the cam shaft is further rotated counterclockwise, cam 81 first unseating valve 67 to release pressure from chamber 25 and then cam 82 unseating valve 68 to release pressure from chamber 22. The arm may be finally lowered after leaving contact with the load, by means of the spring 18 forcing piston 11 inwardly.

After the first operation of the device as before described, the surge chamber is thus charged with fluid under pressure and thereafter, on each operation, the lifting arm may be automatically brought relatively rapidly into contact with the load to be lifted by virtue of rotating the cam shaft 35 clockwise to bring cam 91 into engagement with the stem of the valve 88 to unseat the latter. While the valve 88 is unseated, the fluid under pressure may be forced from chamber 85 by the spring-loaded plunger in the surge chamber, passing through passageways 89 and 77 into the auxiliary chamber 25, and when cam 91 disengages the stem of valve 88 to allow the latter to seat under influence of its loading spring, the surge chamber becomes recharged during the next ensuing operation of the pumping piston to force fluid into the main chamber 22, as before described.

If for any reason the surge chamber should lose its charge or become inoperative, the quick initial contact of the arm 12 with the load may still be effected relatively rapidly by forcing all fluid from chamber 48 through passageways 56, 70, 76 and 77 as before described.

I claim:

1. In a hydraulic jack having a cylinder, a piston therein, a swingable load-lifting arm movable in response to movement of the piston and hydraulic fluid pressure-generating means for supplying pressure to move the piston during load-lifting movement of the arm, hydraulic means for imparting a limited preliminary outward movement of the piston to cause movement of the arm into initial contact with the load, comprising an auxiliary pressure chamber in the cylinder to which an inwardly facing annular surface of the piston is exposed, a body providing a surge chamber having a valve-controlled outlet communicating with the auxiliary pressure chamber and a valve controlled inlet communicating with the pressure-generating means, a plunger in the surge chamber, and a compression spring urging the plunger in a direction to

yieldably oppose admission of fluid under pressure to the surge chamber through said inlet and to force fluid under pressure from the surge chamber to the auxiliary pressure chamber.

2. In a hydraulic jack having a cylinder, a piston therein, a swingable load-lifting arm movable in response to movement of the piston and hydraulic fluid pressure-generating means for supplying pressure to move the piston during load-lifting movement of the arm, hydraulic means for imparting a limited preliminary outward movement of the piston to cause movement of the arm into initial contact with the load, comprising an auxiliary pressure chamber in the cylinder to which an inwardly facing annular surface of the piston is exposed, a body providing a surge chamber having a valve-controlled outlet communicating with the auxiliary pressure chamber and a valve controlled inlet communicating with the pressure-generating means, a plunger in the surge chamber, a compression spring urging the plunger in a direction to yieldably oppose admission of fluid under pressure to the surge chamber through said inlet and to force fluid under pressure from the surge chamber to the auxiliary pressure chamber, valve means for releasing pressure supplied to move the piston during the load-lifting movement of the arm, and mechanical means for lowering the arm from contact with the load, the last-named means comprising a spring normally urging the piston inwardly of the cylinder.

3. In a hydraulic jack, a body providing a cylinder, a piston in the cylinder, the inner end of the piston forming with the cylinder a main pressure chamber and the side of the piston forming with the side wall of the cylinder an auxiliary pressure chamber to which an inwardly facing portion of the piston is exposed, a load-lifting arm swingably carried by the body, means operatively connecting the piston to the arm, means for supplying load-lifting pressure to the main pressure chamber, comprising hydraulic pressure-generating means in the body, a conduit providing communication between the pressure-generating means and the main pressure chamber, a check valve controlling said conduit and yieldably seating towards the pressure-generating means, means for moving the lifting arm into contact with the load, comprising a surge chamber in the body, a valve controlled passageway in the body providing communication between the surge chamber and the auxiliary chamber, a spring-loaded plunger in the surge chamber normally urging fluid from the surge chamber to the auxiliary chamber, a valve-controlled passageway providing communication between the pressure-generating means and the surge chamber, and means for releasing pressure in the main and auxiliary chambers.

4. In a hydraulic jack, a body providing a cylinder, a piston in the cylinder, the inner end of the piston forming with the cylinder a main pressure chamber and the side of the piston forming with the side wall of the cylinder an auxiliary pressure chamber to which an annular portion of the piston is exposed, a load-lifting arm swingably carried by the body, means operatively connecting the piston to the arm, means for supplying load-lifting pressure to the main pressure chamber, comprising hydraulic pressure-generating means in the body, a conduit providing communication between the pressure-generating means and the main pressure chamber, a check valve controlling said conduit and yieldably seating towards the pressure-generating means, a surge chamber in the body, a fluid-passing opening in the body communicating with the surge chamber, a second conduit providing communication between the pressure-generating means and said opening, a third conduit providing communication between said opening and the auxiliary pressure chamber, a plunger in the surge chamber, spring means yieldably urging the plunger towards said opening, a check valve controlling said third conduit and seating towards the auxiliary pressure chamber, and manually operable means for unseating the last-named check valve.

5. In a hydraulic jack, a body providing a cylinder, a piston in the cylinder, the inner end of the piston forming with the cylinder a main pressure chamber and the side of the piston forming with the side wall of the cylinder an auxiliary pressure chamber annularly of the piston, a load-lifting arm swingably carried by the body, means operatively connecting the piston to the arm, means for supplying load-lifting pressure to the main pressure chamber, comprising hydraulic pressure-generating means in the body, a first conduit providing communication between the pressure-generating means and the main pressure chamber, a check valve controlling said conduit and yieldably seating towards the pressure-generating means, a pressure release valve in the first conduit, means for moving the lifting arm into contact with the load comprising a surge chamber communicating with the pressure-generating means, a spring-loaded plunger in the surge chamber yieldably opposing entry of fluid thereto, and a second conduit adapted to pass fluid from the surge chamber to the auxiliary chamber, a poppet valve controlling said second conduit, a pressure release conduit communicating with the main and auxiliary chambers, poppet valve means controlling the pressure release conduit, and means for actuating said poppet valves including a cam shaft rotatably mounted in the body and cams on the shaft selectively engageable against the poppet valves in response to rotation of the cam shaft.

6. The device of claim 3 which includes a spring normally urging the piston into arm-lowering position.

7. In a hydraulic jack, a body providing a cylinder, a fluid reservoir and a receptacle for a hydraulic pressure-supplying unit, a work-lifting arm swingably mounted on the body, a piston reciprocally mounted in the cylinder and operatively connected with the lifting arm, said piston forming with the cylinder a pressure chamber, a fluid passageway in the body communicating with the pressure chamber and a hydraulic pressure-supplying unit detachably mounted in the receptacle, said unit comprising a block having a bore providing a pumping cylinder, a pumping piston reciprocally mounted in the pumping cylinder, a valve-controlled passageway in the block providing communication between the reservoir and the pumping cylinder and a valve-controlled port in the block communicating at one end with the pumping cylinder and communicating at its other end with the fluid passageway in the body.

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