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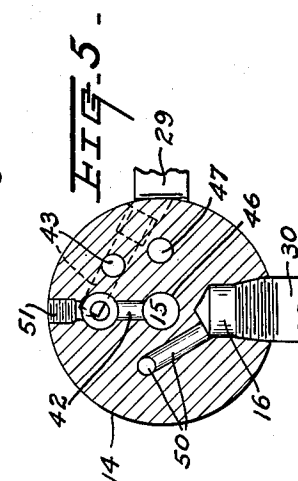
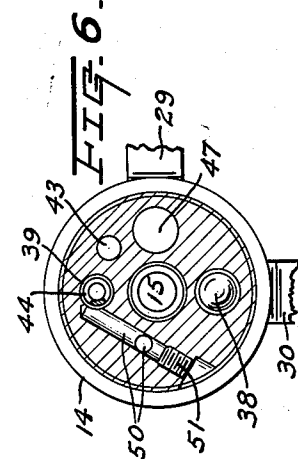
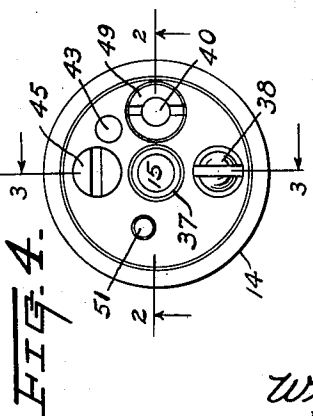
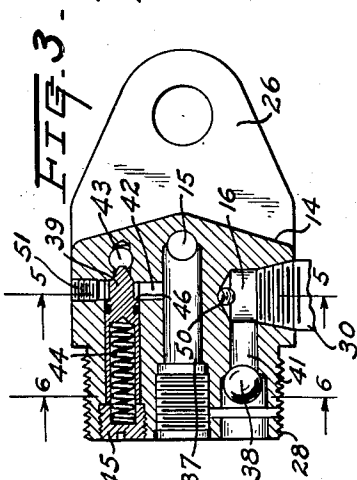
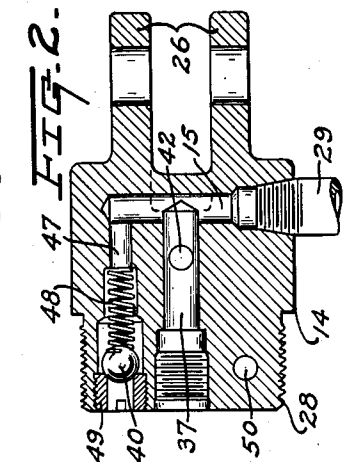
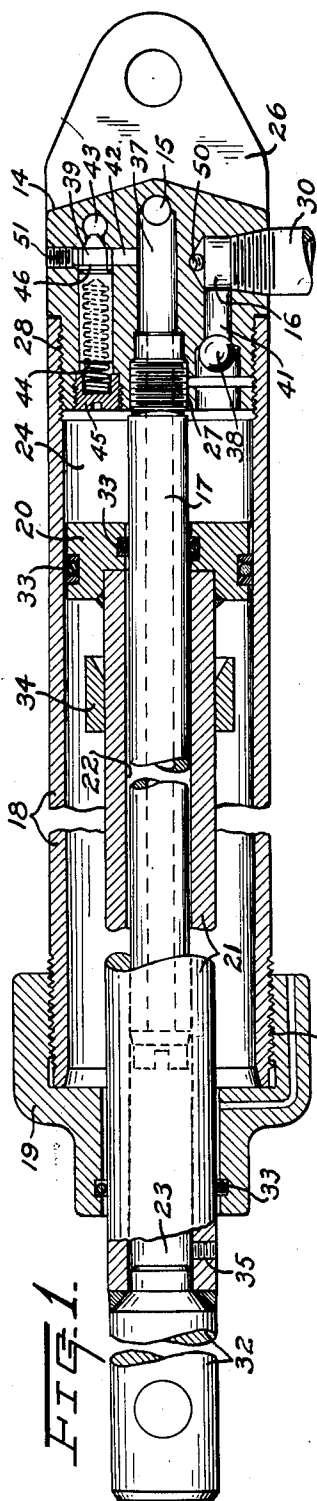
W. A. TRAUT

2,625,796

MULTISPEED HYDRAULIC POWER DEVICE

Filed Feb. 4, 1950

2 SHEETS—SHEET 1



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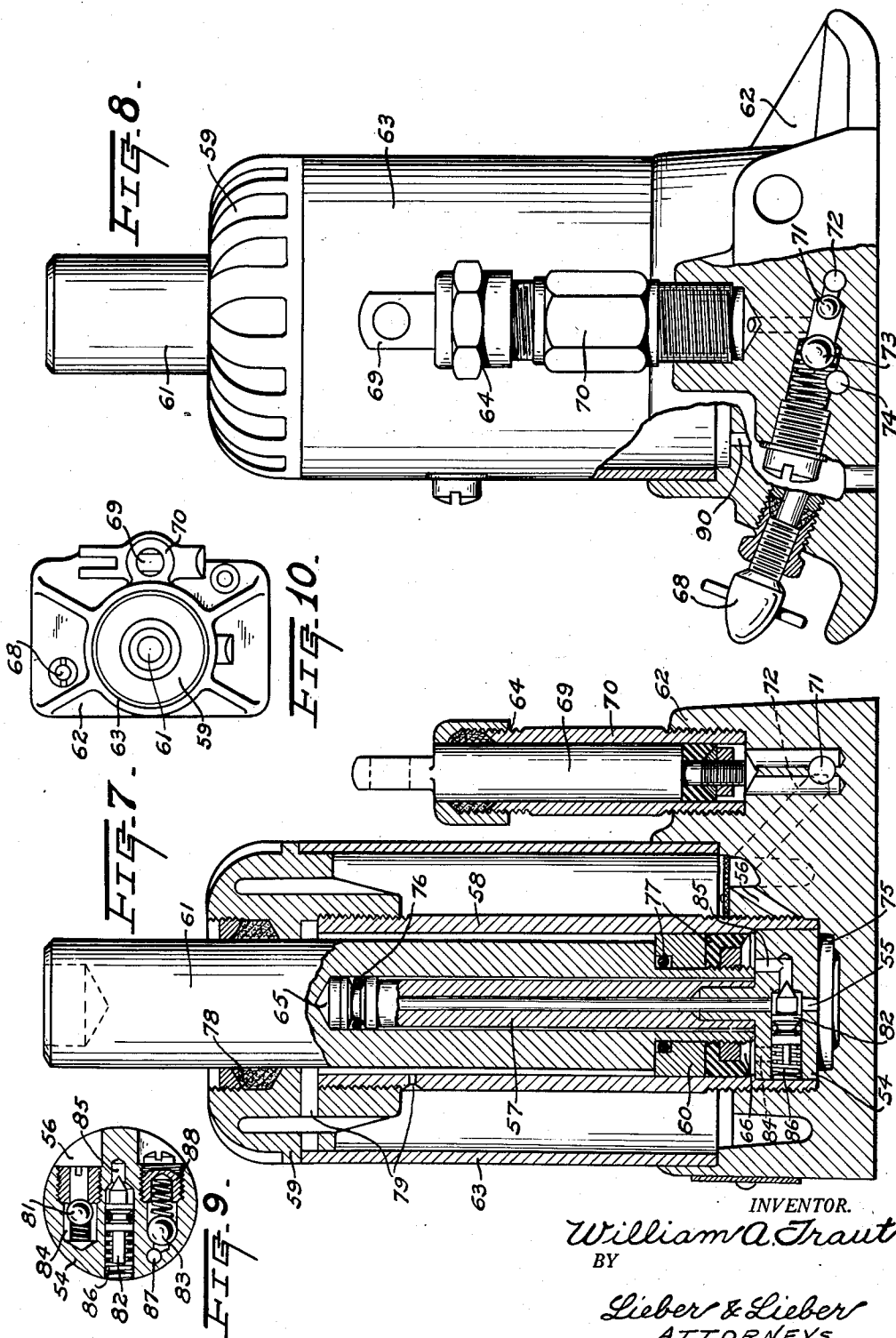
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2 SHEETS—SHEET 2



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UNITED STATES PATENT OFFICE

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MULTISPEED HYDRAULIC POWER DEVICE

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-ration of Wisconsin

Application February 4, 1950, Serial No. 142,402

1 Claim. (Cl. 60—52)

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My present invention relates in general to improvements in the art of hydraulics, and relates more specifically to improvements in the construction and operation of multi-speed hydraulic rams and jacks.

The primary object of the present invention is to provide an improved multi-speed hydraulic power applying device, which is simple and compact in construction, and which is also dependable and efficient in operation.

When hydraulic rams and jacks are being operated, it is frequently desirable to be able to cause the power applying piston or plunger to travel rapidly while approaching a load and to thereafter slow down and develop the necessary power as the load is applied. This is especially the case when the movable piston or plunger has relatively long stroke, and in any event the transfer from high to low speed travel, and vice versa, should be effected positively and automatically. While it has heretofore been proposed to provide apparatus for producing these results, these prior devices have been too complicated and unreliable in operation to warrant general use thereof, and they have also been relatively cumbersome and difficult to assemble and dismantle for inspection and adjustment purposes.

It is therefore an important object of my present invention to provide an improved two-speed ram or jack assemblage which will function automatically and effectively to convert the speed of travel of the power applying member thereof, from high to low and vice versa.

Another important object of the invention is to provide a simple and reliable system for transforming the speed and power of a ram or jack plunger from one value to another, with the aid of simplified and automatically functioning control valves.

A further object of this invention is to provide an improved twin-speed hydraulic power unit which is durable and exceedingly compact in construction so that it may be conveniently manipulated in cramped quarters and utilized for diverse purposes.

Still another object of my invention is to provide an improved multi-speed hydraulic power device which may be readily assembled and dismantled for inspection, wherein various parts are conveniently accessible for adjustment, and which may be manufactured and sold at moderate cost.

These and other objects and advantages of the

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invention will be apparent from the following detailed description.

A clear conception of the various features constituting my present improvement, and of the construction and operation of a ram and a jack assemblage embodying the same, may be had by referring to the drawings accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a fragmentary central longitudinal section through a typical two-speed long stroke hydraulic ram built in accordance with the invention.

Fig. 2 is a central longitudinal section through the base of the ram shown in Fig. 1, the section having been taken along the line 2—2 of Fig. 4;

Fig. 3 is a central longitudinal section through the ram base, similar to that of Fig. 1, and taken along the line 3—3 of Fig. 4;

Fig. 4 is an end view of the ram base looking toward the flow control valves and ports, and with the high-speed piston and the low speed cylinder omitted;

Fig. 5 is a transverse section through the same ram base, taken along the line 5—5 of Fig. 3;

Fig. 6 is another transverse section through the ram base, taken along the line 6—6 of Fig. 3;

Fig. 7 is a central vertical section through a typical high-lift two-speed hydraulic jack also built in accordance with the invention.

Fig. 8 is a part sectional side elevation of the jack assemblage shown in Fig. 7, looking toward the pump thereof;

Fig. 9 is a transverse section through the auxiliary base of the high-speed piston of the jack; and

Fig. 10 is a reduced somewhat diagrammatic top view of the jack shown in Figs. 7, 8 and 9.

In accordance with my present invention, I provide a base member having a main liquid supply communicable with a high pressure source and an auxiliary liquid supply connected to a low pressure liquid source, the base also having a rigid hollow piston coating with the bore of a plunger which is confined within a cylinder secured to the base and cooperating with the fixed piston to produce an annular space within which the plunger is reciprocable by liquid flow controlled by means of a unique series of valves all confined within the base, and while the improvement has been shown and described as being advantageously applicable to oil actuated rams and jacks of specific types, it is not my desire or intent to unnecessarily limit the scope or utility

of the improved features by virtue of this restricted disclosure. It is also contemplated that specific descriptive terms used herein be given the broadest possible interpretation consistent with the actual disclosure.

Referring to Figs. 1 to 6 inclusive of the drawings, the improved two-speed hydraulic ram shown therein, comprises in general a cylindrical base 14 having therein a high pressure liquid inlet and exhaust port 15 and a low pressure liquid supply port 16, and also having a rigid hollow piston 17 projecting therefrom; a cylinder 18 having one end secured to the base 14 and surrounding the fixed piston 17 to provide an annular elongated space enclosed at its opposite end by an annular cylinder head 19; an annular plunger 20 reciprocable within the annular space and having a rod 21 passing through the head 19, the plunger and rod assembly being provided with a central bore 22 snugly but slidably embracing the fixed piston 17; and a series of automatically functioning valves all mounted within the base 14 for controlling the flow of liquid to and from a small high speed plunger displacement chamber 23 located between the inner end of the bore 22 and the free end of the piston 17, and to and from a larger low speed plunger displacement chamber 24 disposed between the base 14 and the adjacent end of the plunger 20.

The base 14 may be formed cylindrical and of a single-piece of metal, and has a pair of pivotal suspension lugs 26 at one end and internal and external screw threads 27, 28 at its opposite end; and the main supply and exhaust port 15 may be connected by a tube 29 with a suitable source of liquid under pressure such as a pump having the usual manually operable relief valve such as the valve 68 of Fig. 8, for returning liquid to its liquid supply reservoir, while the auxiliary port 16 may be likewise connected by a tube 30 with the liquid reservoir from which the pressure pump obtains its liquid supply. The liquid supply pump may either be hand operated or power driven, and when the latter type of drive is utilized a suitable control valve for regulating the speed of travel of the ram plunger 20 should also be provided in a well known manner. The piston 17 is detachably but firmly secured to the screw threads 27 of the base, while the cylinder 18 is likewise secured to the screw threads 28, and both of these tubular elements may be formed of standard tubing of proper length. The cylinder head 19 may also be detachably secured to the cylinder 18 by means of screw threads 31, and the plunger rod 21 may likewise be formed of standard tubing welded or secured to the plunger body 20, or these plunger parts may be formed integral with each other. The outer end of the plunger rod 21 may be provided with a re-enforcing fitting 32 welded or otherwise attached to the tubular rod, and suitable O-type packing rings 33 or the like, may be interposed between the piston 17 and the plunger, and between the latter and the cylinder 18 and head 19, as shown in Fig. 1. The exterior of the plunger rod 21 is also slidably embraced by a stop collar 34 for limiting the outward movement of the plunger 20, and a normally plugged bleeder passage 35 may also be provided at the outer end of the hollow rod 21.

The small or high-speed displacement chamber 23 is in open communication with the main liquid port 15 at all times, through the hollow piston 17 and a central duct 37 in the base 14;

while the larger or low-speed displacement chamber 24 is provided with three automatically functioning flow control valves 38, 39, 40 which may be designated as the suction valve 38, the high pressure supply and unloading valve 39, and the release valve 40 respectively. The suction valve 38 is located in a straight passage 41 connecting the auxiliary liquid supply port 16 with the chamber 24, and is adapted to open automatically whenever the plunger 20 is moving rapidly away from the base 14 so as to permit free flow of liquid into the chamber 24 from the receiver through the auxiliary port 16. The high pressure valve 39 is located between a straight passage 42 communicating with the liquid supply duct 37 and another rather irregular passage 43 which communicates with the displacement chamber 24, and this valve 39 is urged toward its seat by a compression spring 44 coacting with an adjusting plug 45 and is provided with a surface 46 exposed to liquid pressure within the duct 37 and port 15. The release valve 40 is located in still another straight passage 47 which connects the large displacement chamber 24 directly with the main port 15, and this valve is normally seated by a compression spring 48, coacting with a hollow adjusting plug 49 but is adapted to be opened by liquid pressure from within the chamber 24. A drain conduit 50 which is normally sealed by the high pressure valve 39 is also provided, and all of the ports, ducts, passages and conduits may be formed in the base by simple drilling operations and have their dead ends sealed by screw plugs 51.

During normal operation of the improved long-stroke ram unit shown in Figs. 1 to 6 inclusive, and assuming the plunger 20 to be in retracted position, when liquid such as oil under pressure, is admitted from a pump or other controllable source through the tube 29 to the main port 15 the admitted liquid flows without obstruction through the duct 37 and the hollow fixed piston 17 into the smaller displacement chamber 23. If the plunger 20 is unloaded, the liquid thus admitted to the chamber 23 will cause the plunger 20 and its rod 21 and fitting 32 to travel forwardly or away from the base 14 at high speed, and this rapid forward motion of the plunger 20 tends to create a vacuum in the larger displacement chamber 24 thereby unseating the valve 38 by suction and permitting liquid to flow from the storage reservoir through the tube 30, auxiliary port 16 and passage 41 so as to maintain the chamber 24 filled with liquid.

When the forwardly advancing ram plunger 20 engages an obstruction and becomes loaded, the incoming liquid quickly builds up pressure within the main port 15, duct 37 and passage 42 sufficient to open the pressure actuated valve 39 and to thereby admit high pressure liquid through the passage 43 into the larger liquid filled chamber 24 as well as directly to the smaller chamber 23, thereby subjecting the ram plunger 20 to high pressure liquid throughout its entire area. The plunger 20 will then travel at considerably reduced speed and its forward travel may even be arrested while holding the load, and the suction valve 38 will be closed and will remain seated while the plunger 20 is subjected to loading so that no liquid can escape from the chamber 24 to the auxiliary port 16 and reservoir through the tube 30.

During the forward travel of the ram plunger 20 the stop collar 34 will ultimately engage the cylinder head 19 to positively arrest the plunger

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travel, and when it becomes desirable to retract the plunger 20, this may be done by manipulating the usual manually operable by-pass or relief valve to reduce the pressure of the supply liquid admitted through the tube 29 to the port 15. While high pressure continues to act upon the plunger 20 the pressure acting upon the surface 46 will be sufficient to overcome the pressure exerted by the spring 44 upon the unloading or pressure actuated valve 39, so that this valve will remain open. But when the pump pressure is by-passed to relieve the pressure in the supply pipe 29 the valve 40 will open to quickly release liquid from the large displacement chamber 24 directly to the main port 15 through the passage 42. All liquid is thus automatically released and permitted to escape from the displacement chamber 24 during retraction of the ram plunger 20, thus leaving this chamber free to receive a subsequent charge of liquid from the port 15.

The load acting upon the ram plunger 20 and the pressure created by the pump thus function to automatically actuate the valves 38, 39, 40 in accordance with variations in pressure existing within the larger displacement chamber 24, and the opening and closing pressures of the valves 39, 40 may be quickly and conveniently varied by merely unscrewing the cylinder 13 from the base 14 and by thereafter adjusting the screw plug 45, 49, respectively. While the main port 15 serves to admit and release liquid to and from both displacement chambers 23, 24, the auxiliary port 16 only admits liquid to the larger chamber 24 during high speed forward travel of the ram plunger 20, since the suction valve 32 closes immediately when this plunger is loaded, so that the sole function of the valve 33 is to maintain the displacement chamber 24 filled with liquid while high speed operation is being effected. The disposition of all of the valves 38, 39, 40 and the various liquid conducting passages within the base 14 obviously provides an exceedingly compact unit in which all concealed parts are readily accessible.

Referring to Figs. 7 to 10 inclusive of the drawings, the improved two-speed hydraulic jack shown therein, comprises in general a cylindrical base member 54 having therein a high pressure liquid inlet and exhaust port 55 and a low pressure liquid supply port 56, and also having a rigid hollow piston 57 projecting upwardly therefrom; a cylinder 58 having its lower end snugly embracing the member 54 and surrounding the fixed piston 57 to provide a vertically elongated annular space enclosed at its upper end by an annular cylinder head 59; an annular plunger 60 reciprocable within the annular space and having a rod 61 passing through the head 59, the plunger and rod assembly being provided with a central bore snugly but slidably embracing the fixed piston 57; a main base 62 secured to the lower end of the cylinder 58 and clampingly engaging the base member 54 to firmly hold the latter and the piston 57 in fixed position; a liquid supply reservoir 63 secured to the base 62 and coacting with the cylinder head 59 to provide a liquid confining chamber surrounding the cylinder 58; a manually operable pump 64 also mounted upon the base 62; and a plurality of valves for controlling the flow of liquid from the reservoir 63 to and from the high speed piston displacement chamber 65 and to and from the low speed plunger displacement chamber 66.

The base 62 of the jack may be of relatively

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standard construction being provided with the usual manually operable by-pass or release valve 68 for effecting lowering of the jack plunger rod 61, and the pressure supply pump 64 has a manually operable piston 69 reciprocable within a cylinder 70, and is provided with an inlet valve 71 for controlling the withdrawal of liquid through a suction conduit 72 from the supply reservoir 63 and with a spring pressed discharge valve 73 for likewise controlling the delivery of liquid under pressure through another conduit 74 to a supply chamber 75 located beneath the base member 54, see Figs. 7 and 8. The cylindrical base member 54 may be firmly but detachably clamped within the cylinder 58 by attaching the lower cylinder end to the main base 62 with the aid of screw threads as shown, and the cylinder head 59 may be likewise attached to the upper extremity of the cylinder 58, while the piston 57 may also be rigidly attached to a central projection on the base member 54 either by screw threads or otherwise. The hollow piston 57, cylinder 58, and reservoir 63 may all be formed of standard tubing, and suitable packings 76, 77, 78 should be provided between the piston 57 and plunger 60, between the plunger and the cylinder 58, and between the plunger rod 61 and the cylinder head 59, while a bleeder passage and hole 79 should also be provided in the upper portion of the cylinder wall.

The small or high-speed displacement chamber 65 is in constant open communication with the main liquid supply port 55 and with the chamber 75 through the hollow fixed piston 57; while the larger low-speed displacement chamber 66 is provided with three automatically functioning flow control valves 81, 82, 83 all of which are shown in Fig. 9 and may be designated as a suction valve 81, a high pressure liquid supply and unloading valve 82, and a release valve 83. The spring pressed suction valve 81 is located in a series of passages 84 communicating with the port 56 so as to directly connect the liquid supply reservoir 63 with the large displacement chamber 66, and the valve 81 is adapted to open automatically whenever the plunger 60 is being elevated rapidly so as to permit free flow of liquid from the reservoir 63 into the chamber 66 through the passages 84 and port 56. The high pressure valve 82 is interposed between the supply and exhaust port 55 and a passage 85 leading into the large chamber 66, and this valve 82 is urged toward its seat by a spring 86 and is adapted to be opened automatically by high pressure established within the chamber 75 and port 55. The release valve 83 is located in still another passage 87 connecting the larger displacement chamber 66 with the pressure chamber 75 and this valve 83 is normally seated by a compression spring 88, but is adapted to be opened by liquid pressure created within the chamber 66 by the descending plunger 60 and rod 61. The valves 81, 83 are all confined within the member 54 by screw plugs as shown, and the relief valve 68 is adapted to control the release of liquid from the chamber 75 to the supply reservoir 63 through a conduit 90 in a well known manner.

During normal operation of the improved high-lift jack shown in Figs. 7 to 10 inclusive, and assuming the plunger 60 and rod 61 to be in lowered position, when the pump 64 is operated to force liquid under pressure into the chamber 75, pressure liquid will flow directly from this chamber through the port 55 and hollow piston 57 without obstruction into the small

high-speed displacement chamber 65, and will thus cause the plunger 60 and rod 61 to rise rapidly when these elements are unloaded. This upward travel of the plunger 60 will tend to create a vacuum in the larger low speed displacement chamber 66 and will unseat the valve 81 by suction thus permitting liquid to flow freely from within the reservoir 63 through the passages 56, 84 so as to maintain the chamber 66 filled with liquid during high speed rising of the plunger.

When the upward motion of the plunger 60 and rod 61 is obstructed to load the jack, liquid pressure promptly builds up in the passage 55 sufficient to open the valve 82 against the action of the spring 86, and liquid under high pressure is then simultaneously admitted to the small displacement chamber 65 directly through the hollow piston 57 and to the larger displacement chamber 66 through the passage 85, thereby subjecting the plunger 60 to high pressure throughout its entire area. The plunger 60 and rod 61 will then travel at considerably lower speed while loaded and this travel may even be arrested when supporting the load, and the high pressure within the larger chamber 66 will close the valve 81 while the high pressure in the chamber 75 will also maintain the automatic release valve 83 in closed position, so that no liquid can escape from the chamber 66 during loading of the jack.

When it becomes desirable to lower the plunger 60 and its rod 61, it is only necessary to open the relief valve 68, thereby connecting the pressure chamber 75 with the supply reservoir 63 through the return conduit 90. If the relief valve 68 is opened only slightly, the downward motion of the plunger 60 will be slow and the unloading valve 82 will then remain open until the pressure exerted by the spring 86 exceeds the liquid pressure tending to open this valve, whereupon the release valve 83 will open and will ultimately allow all of the liquid to return from the displacement chamber 66 to the reservoir 63 at relatively higher speed until the plunger rod 61 has been fully lowered or retracted.

The improved twin-speed jack thus also functions to automatically actuate the control valves 81, 82, 83 in accordance with variations in pressure existing in the supply chamber 75, and the opening and closing pressures may be regulated by properly manipulating the pump 70 and the by-pass or relief valve 68 and by varying the pressures exerted by the springs upon the unloading valve. Since the displacement of the pump plunger 69 is relatively large compared to that of the fixed piston 57, it will require only a partial stroke of the pump to advance the plunger 60 and rod 61 a considerable distance at high speed, thus insuring quick action; and by opening the relief valve 68 to its fullest extent the movable plunger 60 may also be quickly retracted. While the main liquid port 55 serves to supply and release liquid to and from both displacement chambers 65, 66, the auxiliary port 56 only admits liquid from the reservoir 63 to the larger displacement chamber 66 during high speed upward travel of the rod 61, since the suction valve 81 closes promptly when the jack is loaded. The automatic valves 81, 82, 83 are all readily accessible by merely unscrewing the cylinder 58 from the main base 62, and while these valves may be disposed directly in the main base 62, their disposition within the small base member 54 provides a compact assemblage which can be readily machined, assembled and dismantled.

From the foregoing detailed description it should be apparent that I have in fact provided a simple, compact and durable multi-speed hydraulic power system which is readily applicable to either rams or jacks, and which is automatic and efficient in operation. In both of the typical structures illustrated, the unit is provided with a main high pressure liquid supply and discharge line and with an auxiliary low pressure liquid supply line which merely maintains the low speed displacement chamber filled with liquid while the high speed displacement chamber is in action to rapidly advance the plunger rod. In both assemblages the high speed plunger displacement chamber is in open communication with the liquid pressure source, and admission and discharge of liquid to and from the low speed displacement chamber are controlled by three automatic valves, while both displacement chambers are simultaneously subjected to high pressure when the plunger is loaded.

It should also be noted that by providing unloading springs 44, 86 of different strength, the improved ram or jack may also be utilized to lift light and heavier loads in succession, so that the invention is not confined to units wherein the plungers are merely subjected to either no load or full load. By confining all of these automatic valves in a relatively small base member to which the cylinder is detachably secured, a compact unit results while the valves are also readily accessible for inspection and adjustment. The improved devices can also be readily and accurately machined with the aid of simple tools, and the parts may be conveniently assembled or dismantled thus providing structures which may be manufactured and sold at moderate cost for diverse purposes.

It should be understood that it is not desired to limit this invention to the exact details of construction and operation of the typical ram and jack, herein specifically shown and described, for various modifications within the scope of the appended claim may occur to persons skilled in the art.

I claim:

In a two-speed hydraulic jack, a cylindrical base member having separate high and low pressure liquid passages therein and also having a rigid hollow piston projecting therefrom and constantly communicating with said high pressure passage, a tubular cylinder secured to and embracing said base member and surrounding said piston to provide an annular space, an annular plunger reciprocable within said space and having a bore slidably cooperable with said piston, the free end of said piston coacting with the adjacent end of said bore to provide a small plunger displacement chamber and the end of said plunger facing said base coacting therewith to provide a larger plunger displacement chamber communicable with both of said passages, a suction pressure actuated valve confined within said base for permitting free flow of liquid under low pressure from said low pressure passage to said larger chamber whenever liquid under pressure is being admitted from said high pressure passage to said small chamber to rapidly advance said plunger while the latter is unloaded, an adjustable pressure actuated valve also confined within said base for admitting liquid under high pressure from said high pressure passage to said larger chamber to simultaneously close said suction valve and to advance the plunger at slower speed when loaded, and another pressure actuated

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valve confined within said base for releasing liquid from said larger chamber to said low pressure inlet whenever said plunger is being retracted.

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