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HYDRAULIC JACK

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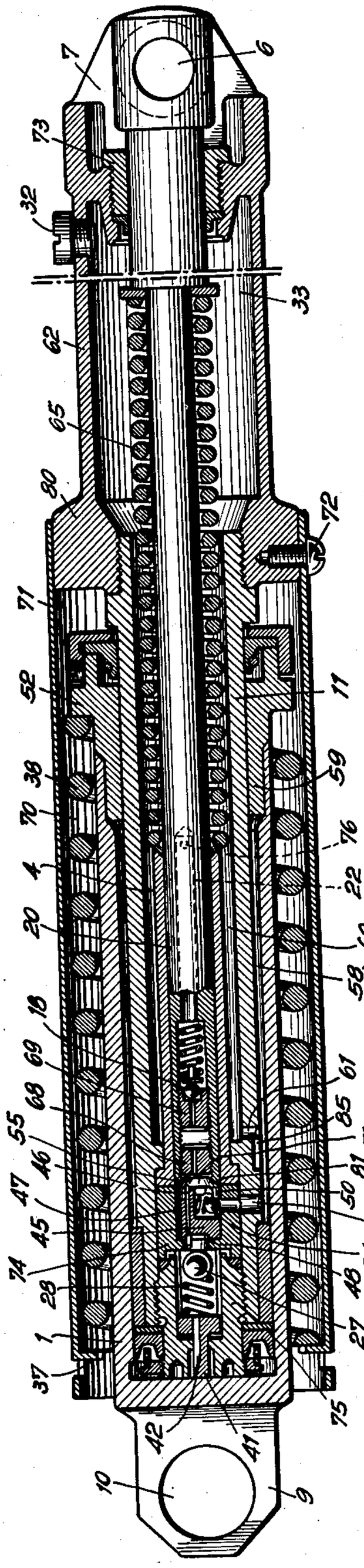

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HYDRAULIC JACK

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This invention relates to hydraulic units for lifting tackles, such as lifting jacks for vehicles, lift trucks and similar devices equipped with hydraulic units consisting of a pump unit, a motor unit, a reservoir for the hydraulic fluid, and the customary accessory equipment.

Limiting the maximum travel of the motor unit in hydraulic devices of this character is ordinarily accomplished by the use of mechanical stops. Since the forces involved are very large, these stops must be of relatively large dimensions. In spite of their large size, breakage of the stops occurs relatively frequently.

This invention deals with the problem of providing means for limiting the maximum travel of the motor piston which is especially intended for utilization in apparatus in which the pump piston, pump cylinder, motor piston, motor cylinder and storage reservoir are arranged co-axially.

The sole figure shows an embodiment of my invention wherein the pump unit **4**, **20** is co-axially positioned within the motor piston **11**. This arrangement of the pump unit in the hollow motor piston **11** of the motor unit **1**, **11** permits limiting the stroke of the motor piston **11**, or of the motor cylinder **1**, without the necessity for providing stops or providing slits in the compression cylinder **1**. In this way difficulties in operation which might otherwise occur because of the presence of such stop members are, to a very great extent, completely avoided.

Referring specifically to the drawing, the motor piston **11** is hollow. Pump cylinder **4** with its pump piston **20** are positioned within the motor piston **11**. A cylindrical continuation **62** of the motor piston **11** is also hollow, and is in communication with the pumping cavity within the motor piston. It is traversed by the pump piston **20**, which is formed with the eye **6** at its end. This eye, in the construction shown, is situated between the two cheeks **7**, which are carried by the continuation **62**, or by a rotatable ring **73**, so that there can be relative axial movement between the cheeks **7** and the pump piston **20**. The interior of extension **62** serves as a supply reservoir **33** for the hydraulic fluid.

The wall **62** of reservoir **33** is stiffened by a reinforcement **80** at the end opposite to eye **6**. At the outer periphery of the reinforcement **80**, there is a jacket **71**, fastened thereto by screws or bolts **72**. This jacket or shell surrounds the compression cylinder, forming therebetween an intermediate space or interstice **70**. Jacket **71** is provided near the end of the motor piston **11** with flanges **37** on one side, but it is otherwise open on

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this side. In the intermediate space **70** there is a return compression spring **38**, which serves for lowering or restoring the device to its initial condition when no load is present. The abutments for compression spring **38** are formed by the beads or flanges **37** on one end, and by closure member **52** of the compression cylinder **1** at the opposite end.

The pump piston **20** is subjected to the action of a return compression spring **65**, which spring, at one end, rests against a recess or shoulder in the pump piston **20** and, at the opposite end, rests against the right hand end of pump cylinder **4**. Along with pump cylinder **4**, there are positioned in motor piston **11** an insert **74** for the suction valve **24**, an insert **75** for motor check valve **27** and a brake valve **41**, **42**.

The brake valve for retarding the return stroke of the motor piston consists of a pin **41** which passes through the left end of motor piston **11** and extends into the motor cylinder **1**. Compression spring **28**, acting on check valve ball **27**, with its opposite end applies a load via a plate or flange to the pin **41**, which is provided with a tapered keyway or fluid passage **42**.

Intake valve support **45** is positioned within the insert **74**, the intake valve support **45** containing intake check valve ball **24**. Furthermore, a pusher element **46** consisting of a pin is axially movable in support **45**. Finally, insertion member **74** is further provided with a channel **47** and hollowed-out portion **48**, which makes for the unimpaired flow of the pumping liquid to the motor piston check valve comprising ball **27**. Pump piston **20** has a conical recess **51**, the mouth edge **50** of which is intended to enter into alternating action with inlet valve ball **24**, while the bottom **55** of the conical recess is intended to press against pin **46**, the opposite end of which acts on the outlet valve ball **27**.

Displacement of pump piston **20** beyond its dead center or ordinary limit of travel (to the left in the drawing), will cause piston **20** and a ring-like extension thereof, **81** to lift the two check valve balls **24** and **27** from their respective seats at the same time retaining a circular configuration at the end of the piston **20**. The left end of piston **20** can therefore be turned at will without impairing the opening of the ball check valves.

Screwed into thef ront side of pump piston **20**, there is a hollow threaded plug **68**, which is intended to engage and displace pin **46** so as to open the motor check valve **27**. As the position of this threaded plug **68** is longitudinally adjustable with respect to piston **20**, its distance away from push

pin 46 can be varied, and it can thus be seen that substantially simultaneous opening of the two ball check valves 24 and 27 takes place.

In the present embodiment of my invention, a safety valve is disposed within the pump plunger 20. For this purpose, another hollow threaded plug 69 is screwed into plunger 20, behind threaded plug 68, its channel being closed by the spring-loaded safety valve ball 18. From safety valve ball 18, an axial bore 22 in piston 20 leads, via a radial channel 76, into an annular space 60 between pump cylinder 4 and compression piston 11.

An annular space 58 is provided between compression piston 11 and the compression cylinder 1. Channel 49 of suction valve 24 leads into this annular space and, furthermore, the wall of the compression cylinder 11 is provided with a channel 61 which connects the annular spaces 58 and 60. Collar 59 of the motor piston closure member 52 is positioned to shut off the openings of channels 49 and 61, said closure member closing off the openings of pump intake channel 49 and the channel 61 leading from the reservoir 33 into the annular space 58 upon completion of the full stroke of motor cylinder 11.

The operation of my improved hydraulic unit will now be described.

The hydraulic liquid is drawn, upon the intake stroke of piston 20 (to the right), out of the reservoir 33, via the annular passage 60, the opening 61, the external annular passage 58 and the pump intake opening 49, when the suction valve 24 is lifted. The power stroke of piston 20 to the left forces the hydraulic fluid through channel 47, recess 48, the housing of spring 28 and the keyway 42 of brake valve 41, into cylinder 1. The return stroke of the pump piston 20 is effected by the spring 65. In the course of the power stroke compression cylinder 1 is moved to the left in the drawing. In accordance with the amount of pressure of the hydraulic fluid during the return stroke of the motor piston 11, the pin 41 is displaced against the action of compression spring 28, the pin 41 moving towards the right in the drawing. With increased displacement of pin 41 toward the right the effective flow cross-section is reduced by reason of the tapering of the keyway or slot 42. This cushions the return stroke and meters the return flow through keyway 42.

With the displacement of cylinder 1 during the power stroke, the sealing collar 59 comes closer and closer to the mouth of the two channels 61 and 49. Finally, it happens that, first, the mouth of channel 61 (and, possibly thereafter if displacement of motor piston 11 is continued the mouth of channel 49), is covered by the collar, so that the pump piston 20 can no longer draw out pressure liquid during the suction part of the stroke from the annular spaces 58 and 60, or from the reservoir 33. In this way, the pumping is terminated, and this also results in termination of the power stroke of the motor cylinder and motor piston.

With the lifting of check valve balls 24 and 27 from their seats by maximum displacement of pump piston 20, (towards the left in the drawing), the liquid contained in compression cylinder 1 can flow back during the return stroke. The collar 59 which, incidentally is made of metal, is not stressed at any time by the closing of the passages 61 and 49, inasmuch as it is not under pressure.

There is connected to channel 61, at the outer

wall of compression piston 11, a groove 85 extending in the direction of channel 49. By means of this groove any hydraulic fluid in the annular space 58, which remains after the termination of the stroke, is reduced to a minimum amount, and return of the pressure liquid into the annular spaces 60 and the supply receptacle 62 is facilitated.

It should of course be understood that various changes and modifications can be made in my invention as herein described which would fall within the scope of my invention, and it is my intention that such changes or modifications as are within the purview of the appended claims shall be considered as part of my invention.

What I claim is:

1. A hydraulic unit of the class described, comprising: a motor cylinder, a motor piston movably disposed within the motor cylinder and having a pump cylinder and closable pump inlet passage formed therein said pump cylinder communicating through outlet check valve means with the motor cylinder; a pump piston reciprocally disposed within the pump cylinder; a reservoir adapted to contain hydraulic fluid; inlet check valve means carried by the motor piston and disposed to admit fluid from the reservoir through said pump inlet fluid passage into the pump cylinder upon the suction stroke of the pump piston; and closure means carried by the motor cylinder and disposed to close said pump inlet fluid passage in response to a predetermined maximum movement of the motor piston relative to the motor cylinder, whereby the maximum stroke of the motor piston is limited by making the pump ineffective.

2. A hydraulic unit according to claim 1, wherein said pump inlet fluid passage comprises two open ends successively closable by said closure means.

3. A hydraulic unit according to claim 1, further comprising a return flow regulating member carried by the motor piston, said regulating member being yieldingly movable with respect to said motor piston and having a tapered passageway formed therein, said passageway being progressively restricted during the final period of motor retraction for metering the rate of said return flow.

4. A hydraulic unit of the class described, comprising: a pump piston; a motor piston having a pump cylinder formed therein, said pump piston being reciprocably disposed within said pump cylinder, said motor piston having first and second fluid passages formed therein, said first fluid passage extending from the exterior portion of said motor piston into said pump cylinder; a first check valve means carried by said motor piston and disposed in said first fluid passage for admitting fluid into said pump cylinder; a reservoir adapted to receive hydraulic fluid; a motor cylinder within which said motor piston is movably disposed, a third fluid passage formed in said motor piston, said third passage being closable and communicating between said reservoir and said first fluid passage, said second fluid passage communicating between said pump cylinder and said motor cylinder; a second check valve means carried by said motor piston and disposed in said second fluid passage for admitting fluid from said pump cylinder into said motor cylinder; and closure means carried by said motor cylinder and effective after a predetermined maximum movement of said motor piston and to close said first fluid passage.

5. A hydraulic unit according to claim 4, wherein said closure means is disposed to close said third fluid passage prior to the closure of said first fluid passage.

6. A hydraulic unit according to claim 4, wherein said pump cylinder and said motor cylinder are coaxially disposed, said third fluid passage communicating with a space intermediate the internal surface of said motor cylinder and the external surface of said pump cylinder.

7. A hydraulic unit according to claim 4, further comprising release means carried by said pump cylinder and operative in an extreme pressure stroke position of travel of said pump piston for opening both said first and second check valve means to permit reverse fluid flow therethrough; and flow retarding means disposed in said second fluid passage for metering the rate of said reverse flow during the final period of motor retraction.

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