April 15, 1952 J. G. CATRANIS 2,592,656

PISTON AND VALVE ASSEMBLY FOR HYDRAULIC CONTROL DEVICES

Filed Nov. 19, 1948

FIG. 1

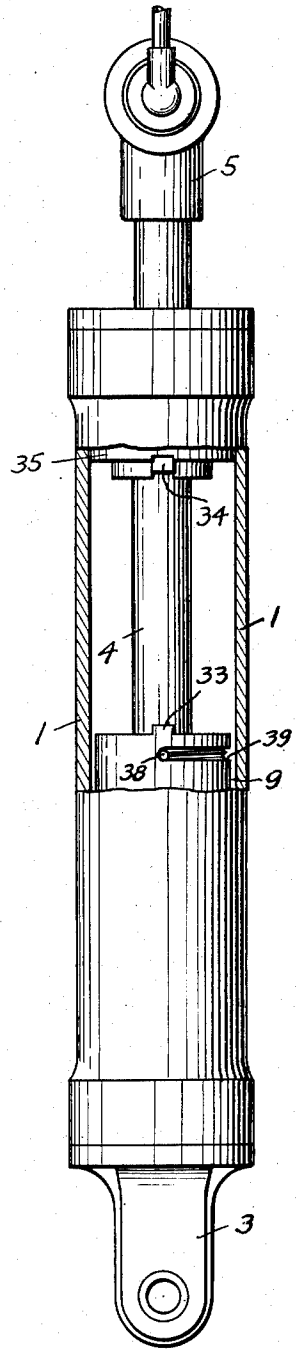



FIG. 2

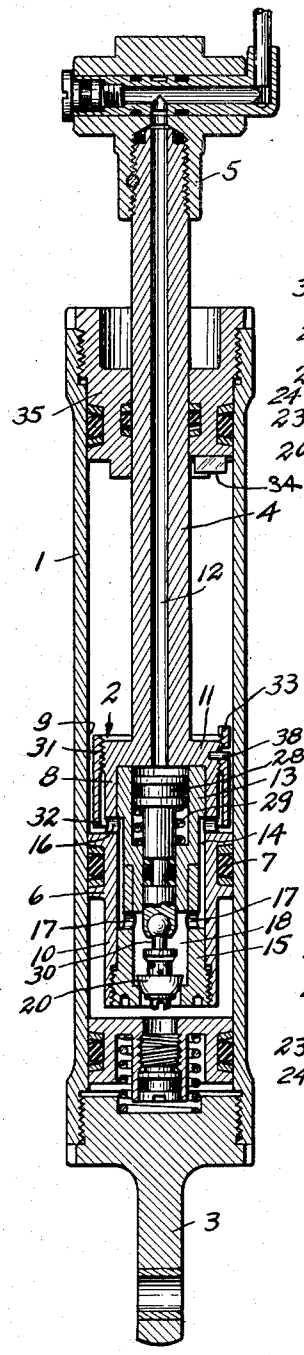



FIG. 3

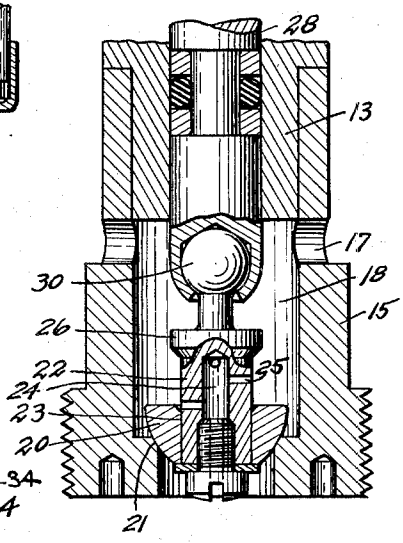
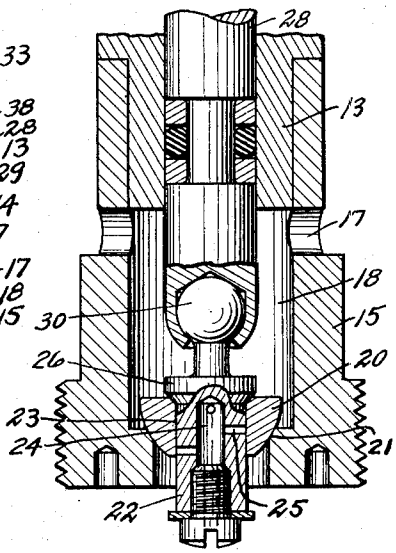



FIG. 4




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## PISTON AND VALVE ASSEMBLY FOR HYDRAULIC CONTROL DEVICES

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5 Claims. (Cl. 188—96)

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This invention relates to hydraulic variable retarding devices, as cylinder and piston dash pots, and has for its object a check and control valve assembly in the piston for controlling the flow of fluid through by-passes from one side of the piston to the other side, which assembly is particularly simple and compact.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a side elevation, partly broken away, of a cylinder and piston retarding device or dash pot embodying this invention.

Figure 2 is a longitudinal sectional view taken centrally of Figure 1.

Figure 3 is an enlarged fragmentary sectional view of the piston construction showing the check valve and the throttle valve controlling the flow of fluid through the by-pass from one end of the cylinder to the other when the valves are in normal or starting position.

Figure 4 is a view, similar to Figure 3, showing the position of the valves when in fully operated position.

The invention resides in the piston having a by-pass extending lengthwise thereof and opening through the opposite ends or pressure faces thereof, a check valve in the by-pass to check the flow of fluid in one direction, a second by-pass around the check valve, a self-opening throttle valve in the piston and also an operating member in the piston operable to progressively close the second by-pass, and means for operating the throttle valve from outside of the cylinder and piston.

One of the features of the invention is the throttle valve mounted to shift axially in a passage in the check valve, the throttle valve being formed with a second by-pass leading from the first by-pass through the outer end of the throttle valve and opening into the cylinder.

The construction here shown is intended primarily to control the operation of the knee lock of an artificial leg and operable by the action of the stump of the natural leg in the socket of the artificial leg, or by the contraction and relaxation of thigh muscles, such as the quadriceps tendon, as in my application, Sr. No. 779,011, filed October 10, 1947, now Patent No. 2,568,051, issued September 18, 1951.

1 and 2 designate respectively the cylinder and piston of a hydraulic retarding device or double

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acting dash pot, these having relative axial movement, the cylinder 1 having a bracket 3 at its lower end for connection to a fixed point, and the piston 2 having a rod 4 provided with a coupling 5 for pivotal connection to a bracket at the lower end of the socket of the leg, the pivotal connection being eccentric to the axis of the knee joint or pin. The piston in this embodiment may be considered as movable in the cylinder. The piston rod 4 and the joint 5 are here shown as formed with a passage for a hydraulic fluid, which fluid operates a throttle valve operating member and is itself motivated by a thigh muscle control.

The piston 2, as here shown, comprises a body having an intermediate portion 6 having sealing or piston rings 7 for coacting with the wall of the bore of the cylinder and a reduced portion 8 at one side, as the upper side of the intermediate portion, the reduced portion 8 being spaced from the walls of the cylinder 1 providing an annular space 9. The piston is shown as also having a depending portion 10 on the other side or below the intermediate portion 6. The body and its reduced portions are formed with an axial bore opening through the lower edge of the reduced portion 10 and terminating short of the upper end of the body 2, providing a head at 11 from which the piston rod 4 projects, the bore 12 of the piston rod opening into the bore of the piston body.

13 designates a cage or casing fitted at one end, as the upper end, into the upper end of the bore of the piston body and depending into the bore of the piston body but spaced apart at 14 from the wall of the bore to provide an annular chamber.

15 designates a plug or second casing threading into the lower end of the piston body and telescoping on the lower end of the cage 13. Radial ports 16 in the piston body 6 connect the annular spaces 9 and 14 and radial ports 17 connect the radial spaces 14 and the internal chamber 18 in the plug 15. These spaces 9, 14, and radial ports 16, 17, form a by-pass from one end of the cylinder to the other. The chamber 18 opens through the outer end, that is the lower end of the plug 15.

20 designates a fluid pressure operated check valve located to check the flow of fluid in one direction, as downwardly, from above the piston through the lower end thereof, this being shown as semi-spherical and coacting with a seat at 21 on the walls of the chamber 18 where it opens through the lower end of the plug 15.

22 designates the throttle valve, this being slid-

able through a passage at 23 in the check valve, it having an axial bore 24 opening through its lower end and laterally extending ports 25 opening through the periphery thereof and normally opening into the chamber 18. The throttle valve is normally in the position shown in Figure 3, and is shiftable downwardly so that the ports 25 are covered or cut off progressively. The throttle valve is also provided with a head 26 seating on the check valve when the throttle valve is fully closed and thus holding the check valve closed. The passage 24 and radial ports 25 constitute a second by-pass around the check valve. The throttle valve may be actuated in any suitable manner. It is here shown as self opening and actuated hydraulically to closed position by a piston or plunger 28 in the upper portion of the bore of the casing 13 and pressed upwardly by a spring 29. The casing communicates with the passage of the piston rod 4, previously referred to, so that any pressure created by the action of the thigh muscles is transferred to the plunger 28 when this device is embodied in a knee lock mechanism of an artificial leg. When actuated, the plunger 28 is pressed downwardly and through a coupling 30 actuates the throttle valve towards closed position an amount corresponding to the tension or relaxation of the thigh muscles.

In order to adjust the effective cross sectional area of the by-pass, a gate 31 in the form of a sleeve threads on the upper reduced portion of the body 6 of the piston and is adjusted axially to carry its lower edge 32 in position to cut off more or less the radial passages 16. This sleeve or gate does not entirely fill the annular passage 9. One way of initially adjusting it is to pull the piston upward until the lug 33 interlocks on one side or the other of a key 34 at the lower end of the head 35 of the cylinder 1 and the piston rod is given a partial turn and thereby turning the upper end of the piston body 6 in the sleeve while the gate is held from turning movement. In order to limit this relative turning movement, a radial pin 38 on the upper portion of the piston body 6 moves in an arcuate slot 39 in the gate.

This piston and valve assembly is particularly compact and the valve operation sensitive to such small forces as are generated by relative movement between the stump of a leg and the socket of the artificial leg, such as are generated by the tension and relaxation of thigh muscles.

What I claim is:

1. A piston and valve assembly for hydraulic control devices which comprise a cylinder and a piston having relative axial movement, the piston having a by-pass opening through its pressure faces at opposite ends thereof, a check valve in the by-pass to check the flow of fluid in one direction, a second by-pass in the piston around the check valve, a self-opening throttle valve operable to close the second by-pass, and means in the piston for operating the throttle valve, the throttle valve being mounted to shift axially in an axial passage in the check valve and being formed with the second by-pass leading from the first by-pass through the outer end of the throttle valve, and the operating means being located in the piston in axial alinement with the throttle valve, the throttle valve having a head for coacting with the check valve to press against and hold the check valve closed when the throttle valve is fully closed.

2. A piston and valve assembly for hydraulic control devices which comprise a cylinder and a piston having relative axial movement, said piston comprising a body having an axial bore opening through one end, a check valve casing disposed in said bore and forming a substantially axial chamber in the piston, a second casing mounted in axial alinement in the bore of the piston, a pressure operated check valve in the check valve casing and coacting with a seat therein, an axially movable throttle valve in said chamber and movable through an axial bore in the check valve, the throttle valve having an axial bore opening through its outer end and radial ports opening into said chamber, a spring-returnable, throttle-operating member axially movable in the second casing and connected to the throttle valve, a by-pass extending lengthwise of the piston from one pressure side thereof to the other including said chamber, the bore and ports of the throttle valve constituting a second by-pass around the check valve, and means for operating the throttle valve operating member from outside of the cylinder and piston.

3. A piston and valve assembly for hydraulic control devices which comprise a cylinder and a piston having relative axial movement, said piston comprising a body having an axial bore opening through one end, a check valve casing disposed in said bore and forming a substantially axial chamber in the piston, a second casing mounted in axial alinement in the bore of the piston, a pressure operated check valve in the check valve casing and coacting with a seat therein, an axially movable throttle valve in said chamber and movable through an axial bore in the check valve, the throttle valve having an axial bore opening through its outer end and radial ports opening into said chamber, a spring-returnable, throttle-operating member axially movable in the second casing and connected to the throttle valve, a by-pass extending lengthwise of the piston from one pressure side thereof to the other including said chamber, the bore and ports of the throttle valve constituting a second by-pass around the check valve, and means for operating the throttle valve operating member from outside of the cylinder and piston, and an adjustable gate on the piston to vary the effective cross sectional area of the first by-pass.

4. A piston and valve assembly for hydraulic control devices which comprise a cylinder and a piston having relative axial movement; said piston comprising a body having an intermediate portion for coacting with the walls of the bore of the cylinder, a reduced portion at one side of the intermediate portion providing an annular space, a hollow piston rod connected to the reduced portion, the piston also having an axial bore extending through its other end and also extending into the reduced portion, a check valve casing and a second throttle-valve-operating member casing located in axial alinement in said bore, the first casing providing a chamber within the piston and having radial ports opening into a second annular space between said casings and the wall of the bore of the piston, the piston having radial ports connecting the first and the second annular spaces, a pressure operated check valve in said chamber and coacting with a seat at the outer end of the chamber, a throttle valve extending axially through the check valve and axially into the chamber and formed with an axial passage opening through its outer end, and radial ports opening into the chamber, a spring-returnable throttle-valve-operating plunger in the

second casing connected to the throttle valve, and means for operating said plunger from outside of the cylinder and piston.

5. A piston and valve assembly for hydraulic control devices which comprise a cylinder and a piston having relative axial movement; said piston comprising a body having an intermediate portion for coacting with the walls of the bore of the cylinder, a reduced portion at one side of the intermediate portion providing an annular space, a hollow piston rod connected to the reduced portion, the piston also having an axial bore extending through its other end and also extending into the reduced portion, a check valve casing and a second throttle-valve-operating member casing located in axial alinement in said bore, the first casing providing a chamber within the piston and having radial ports opening into a second annular space between said casings and the wall of the bore of the piston, the piston having radial ports connecting the first and the second annular spaces, a pressure operated check valve in said chamber and coacting with a seat at the outer end of the chamber, a throttle valve extending axially through the check valve and axially into



the chamber and formed with an axial passage opening through its outer end, and radial ports opening into the chamber, a spring-returnable throttle-valve-operating plunger in the second casing connected to the throttle valve, and means for operating said plunger from outside of the cylinder and piston, and an annular gate adjustable axially of the reduced portion of the piston to vary the effective size of the radial ports between the annular spaces.

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