Feb. 13, 1951 R. H. DAVIES 2,541,464

FLUID THROTTLING VALVE

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Fig. 1

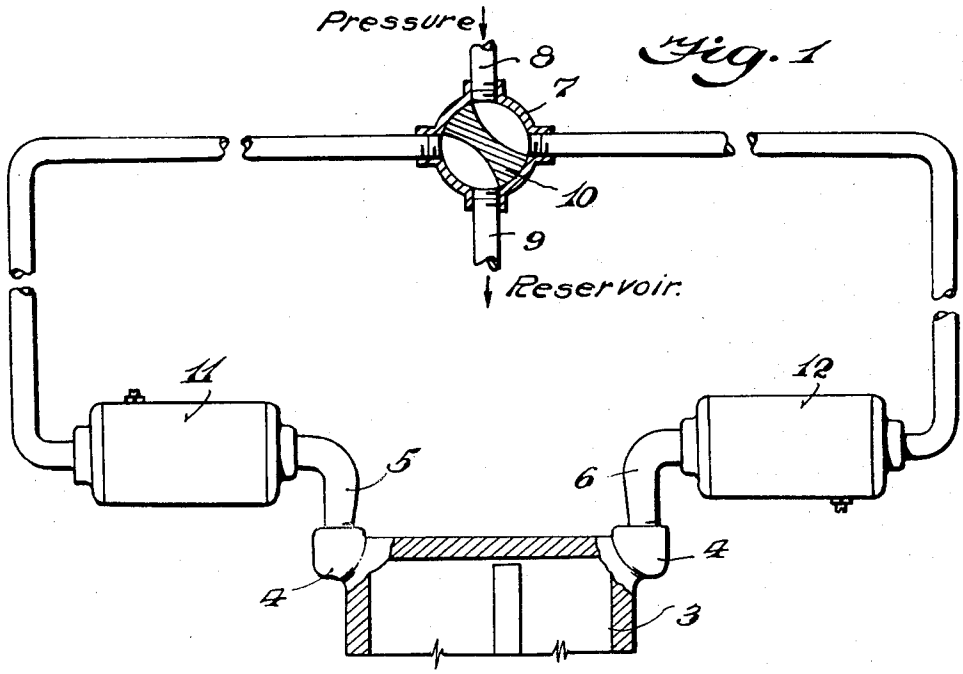
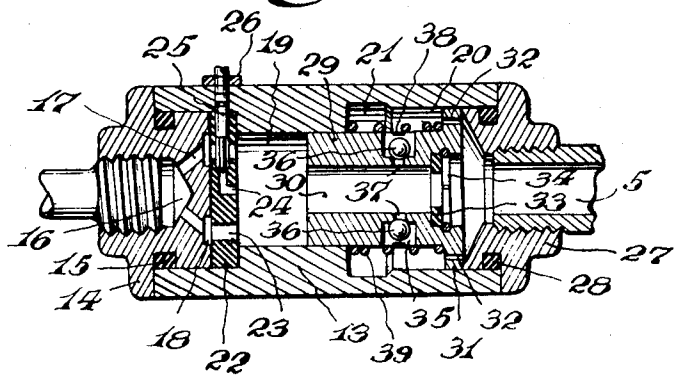


Fig. 2



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FLUID THROTTLING VALVE

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3 Claims. (Cl. 121—38)

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The following description relates to my improvement in hydraulic cushioning means for operating pistons and the novel system of operation incident thereto.

Where pistons are reciprocated in cylinders to produce reciprocating movement, the fluid pressure applied to the pistons is difficult to control and especially when the results are dependent in large measure upon the load on the piston or the work required to be done. In the event that a load is light the application of the full pressure may result in reciprocating the piston with an undesired violence and force especially as it approaches the end of a reciprocating movement. I have found that it is possible to use the fluid pressure itself to control or retard the movement of the piston.

One of the objects of my invention is to utilize the fluid displaced by the piston as a means for controlling the speed of the movement and limiting it to that previously found to be desirable.

A further object of my invention is to provide means by which the control may be varied and adjusted dependent upon different operating conditions and the size of the piston being actuated.

A still further object of my invention is to retard or otherwise control the rapidity of the piston movement by throttling the discharge of the fluid pressure displaced by the piston.

A still further object of my invention is to decelerate the piston at its final or terminal movement with a cushioning effect which will permit it to reach its ultimate position.

Other objects of my invention will be apparent from the description of the preferred form as illustrated in the accompanying drawings.

In these drawings:

Figure 1 is a diagrammatic side elevation partly in section of the pressure operating means applied to a reciprocating piston with my improved retarding means,

Fig. 2 is a longitudinal vertical section of the novel hydraulic retarding fuse utilized.

The mechanical arrangements of the device provide a system whereby the piston in an operating cylinder may be reciprocated by a fluid pressure under a control imposed by the volume and rate of the fluid displaced by the piston in its advance. Broadly speaking the impovement is in the adaptation of an improved hydraulic fuse to control the movement of the piston, its final decelerated or retarded travel and its freedom to reciprocate in the opposite direction.

I have shown the operating power cylinder 3 adapted to cooperate with a reciprocating piston. Each end of the cylinder has a port 4 with which lines of piping 5 and 6 connect effectively to a reversing valve 7. This reversing valve 7 has an inlet pipe 8 and a discharge pipe 9 which latter leads to an accumulator or reservoir. The valve member 10 in the reversing valve is adapted to

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direct fluid pressure from the pipe 8 into either pipe 5 or 6. The pipe 5 or 6 that is not so connected will in this movement be connected to the discharge pipe 9 to the reservoir. It will of course be understood that the valve member may be placed in an intermediate position in which the flow of pressure fluid and discharge fluid is stopped and the system remains stationary.

In order to carry out the purposes of the invention means can be provided between the ports 4, 4 and the reservoir to serve as throttling and retarding means for the discharge. In many instances it will be possible to place this controlling means on the pipe 9 where it will receive the discharge through either connection 5 or 6.

However, in view of operating advantages in many instances, it is desirable to provide separate hydraulic fuses to serve as controlling means on each connecting pipe 5 or 6.

The valve 11 has been shown as interconnected on the pipe 5 between one port 4 and the reversing valve 7. In the position of the latter shown in Figure 1 the valve 11 will operate since it is the discharge from the cylinder 3.

The valve 12 in the opposite connection 6 is in the pressure line from pipe 8 and will permit unrestricted flow from the latter.

Each of the valves 11 and 12 are identical and for the purpose of illustration valve 11 has been selected for detailed description (Fig. 2). The valve 11 consists of a body member 13. This body member has an end cap 14 bolted or otherwise attached to the body 13 and providing a connection to the discharge side of the pipe 5. A suitable packing 15 seals the cap 14 to the body 13. The cap has a central bore 16 and divergent passageways 17 connecting to a circular groove 18.

The body 13 has an intermediate cylindrical valve chamber 19 while one end has a relatively large dashpot 20 aligned with the chamber 19. An enlargement 21 connects the dashpot 20 with the end wall of the valve chamber 19.

The valve chamber 19 is spaced from the inner face of the cap 14. This provides room to receive the valve seat 22. The latter is in the form of a flat disk and may be of metal or of hard rubber or the like. It is free from stress as it is not compressed unduly between the cap 14 and the end wall of the valve chamber 19. Therefore the valve seat 22 provides a flat surface to receive the end of the valve proper.

A series of openings 23 pass through the valve disk 22 and connect the chamber 19 with the circular groove 18. In this way the passageways 17 are at all times open to the openings 23.

When the valve is upon the seat 22 and the openings 23 are closed, it is desirable to by-pass a limited volume of pressure fluid. For this purpose a central opening 24 has been provided and an angular portion of the opening intersects one of the openings 23 in a radial direction. A nee-

dle valve 25 passes radially through the disk 22 and the body or casing 13. The needle valve is screw threaded into the casing 13 and held in adjusted position by means of lock nut 26.

The opposite end of the casing 13 has a cap 27 bolted or screwed thereon and connected with the branch of the pipe 5 leading from the cylinder. The cap has a leakproof packing 28.

A valve 29 with a central bore 30 reciprocates in the valve chamber 19 with a relatively close clearance. A flange 31 extends laterally from the inlet end of the valve 29 to form a slide bearing against the wall of the dashpot 20. Metering openings 32 pass through this flange and serve as a control for the closing movement of the valve.

The central bore 30 is enlarged at the inlet end to receive a meter disk 33 which is held in by the split ring 34.

The valve 29 is bored diametrically to provide recesses 35, 35 which contain check balls 36, 36. These balls seat in circular openings 37 and form ball check valves. A split ring retainer 38 fitted in a groove in the outer surface of the valve 29 confines the balls 36, 36 against displacement. A spiral spring 39 holds the valve normally in its open position as shown in Fig. 2.

Briefly the action of the valve is dependent upon a differential in pressure between the inlet of the discharge fluid and its outlet through the valve chamber 19. This pressure causes the valve 29 to move slowly toward its seat and at the same time compression in the dashpot closes the ball check valve. The rate of travel of the valve 29 is dependent upon the number and size of the metering outlets 32. The valve continues its closing movement until the flange 31 is opposite the enlargement 21 when the movement is accelerated to bring the valve into closing contact with the valve disk 22.

The ball check valve 36 is effective during the closing movement but not in the opening movement.

The metering disk 33 functions to control the rate of flow through the valve 29. The greater the opening in the metering disk 33 the greater will be the rate of flow existing in the discharge fluid before the valve 29 starts its closing movement.

The valve is so calibrated as to remain open during the normal movement of the piston in the cylinder 3 and to function to close only when it is desired to slow down or cushion the final part of the piston reciprocation. This result is accomplished by providing for the valve to close before the piston completes its travel. Thereafter the further discharge of fluid necessary to permit the piston to come to its limit of movement is effected at a restricted rate through the by-pass opening 24 to a passageway 23.

By adjustably positioning the needle valve 25 the rate of this by-pass flow can be adjusted to provide any desired cushioning effect upon the piston.

In reverse movement when the piston reciprocates in the opposite direction the spring 39 holds the valve off of its seat and fluid passes through the hydraulic valve in reverse direction in full volume. The valve is therefore promptly restored to its open position ready for carrying out the cushioning effect in the next reciprocation.

It will be understood that the cushioning hydraulic valve 11 operates on discharge through the pipe 5 and at the same time the valve 12 is open and inactive. Reciprocation in the opposite direction places the valve 12 in operation and renders the valve 11 inactive.

The general features of the hydraulic valve utilized are those disclosed and claimed in the copending application of Emmett C. Hartley and Harry B. Carbon, filed November 22, 1944, Serial No. 564,640, now Patent No. 2,518,988 issued August 15, 1950.

It is to be emphasized that the arrangement of the features above described provides a system of operating and controlling reciprocating motion which may be carried out by either the device as above illustrated or a similar one which may be different in many respects without departing from the scope of the following claims.

I claim:

1. In combination, a cylinder, a piston reciprocable therein, a port at each end of the cylinder, a reversing valve connected to a source of fluid under pressure, connections between each port and said valve, a discharge connection from the valve to a reservoir, and a hydraulic valve interconnected between each port and the reversing valve, said hydraulic valve having means responsive to back pressure acting at a predetermined excess rate of fluid discharge to bring the valve into normally closed position after a predetermined period of discharge, and an auxiliary open passageway through the normally closed valve.

2. In combination, a cylinder, a piston reciprocable therein, a port at each end of the cylinder, a reversing valve connected to a source of fluid under pressure, connections between each port and said valve, a discharge connection from the valve to a reservoir, and a hydraulic valve interconnected between each port and reversing valve, said hydraulic valve having a movable valve member, and time-delay means acting on said valve member at a predetermined excess rate of fluid discharge to reduce the flow through the valve after a predetermined period of discharge.

3. In combination, a cylinder, a piston reciprocable therein, a port at each end of the cylinder, a reversing valve connected to a source of fluid under pressure, connections between each port and said valve, a discharge connection from the valve to a reservoir, and a hydraulic valve interconnected between each port and the reversing valve, said hydraulic valve, said hydraulic valve having a movable valve member, and time-delay means acting on said valve member at a predetermined excess rate of fluid discharge to reduce the flow through the valve after a predetermined period of discharge, metering means in the valve member for variably controlling said flow period, and an auxiliary open passageway through the normally closed valve.

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