June 23, 1970 W. A. RAY 3,516,332

HYDRAULIC SYSTEM

Filed June 17, 1968 2 Sheets-Sheet 1

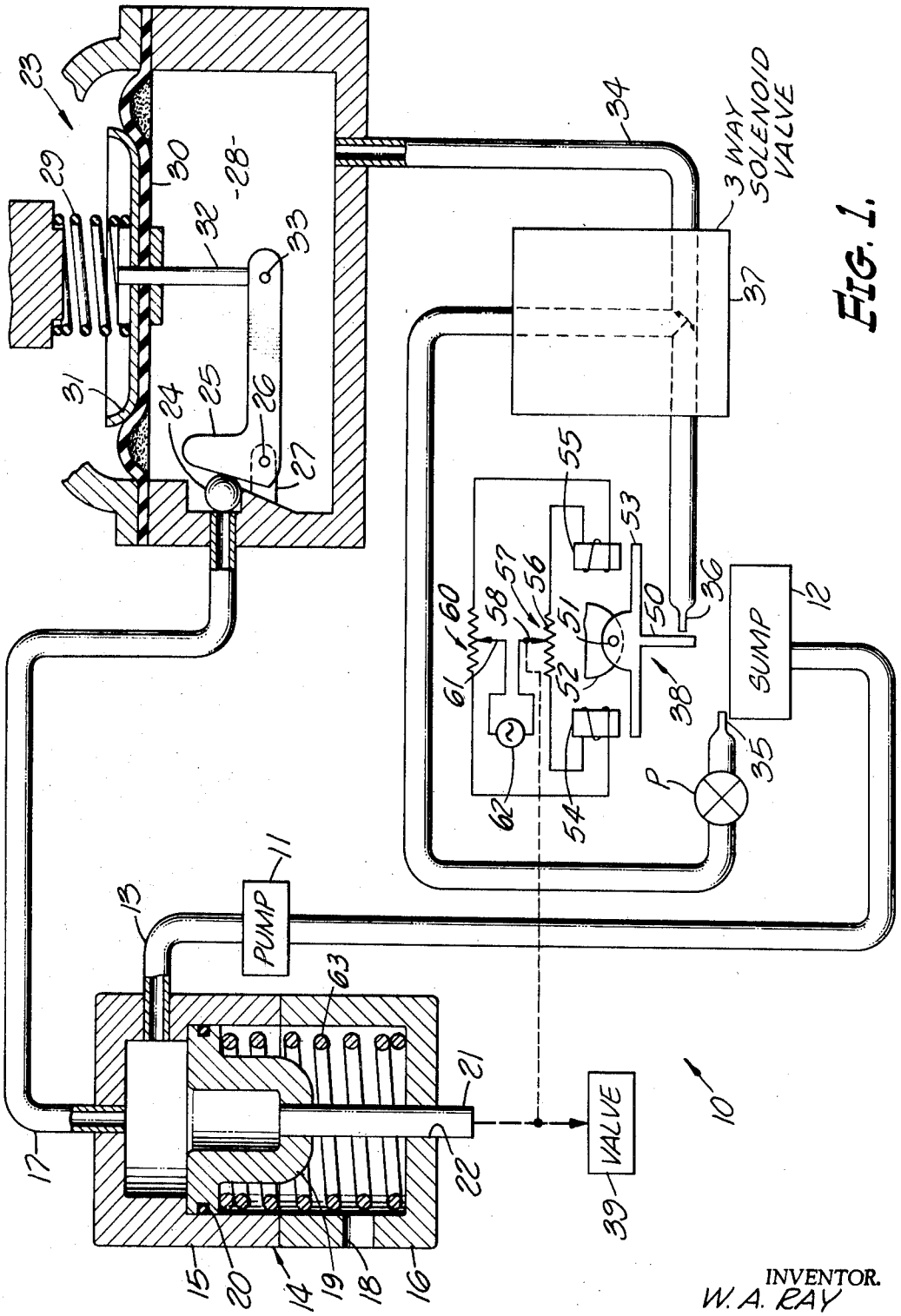


FIG. 1.

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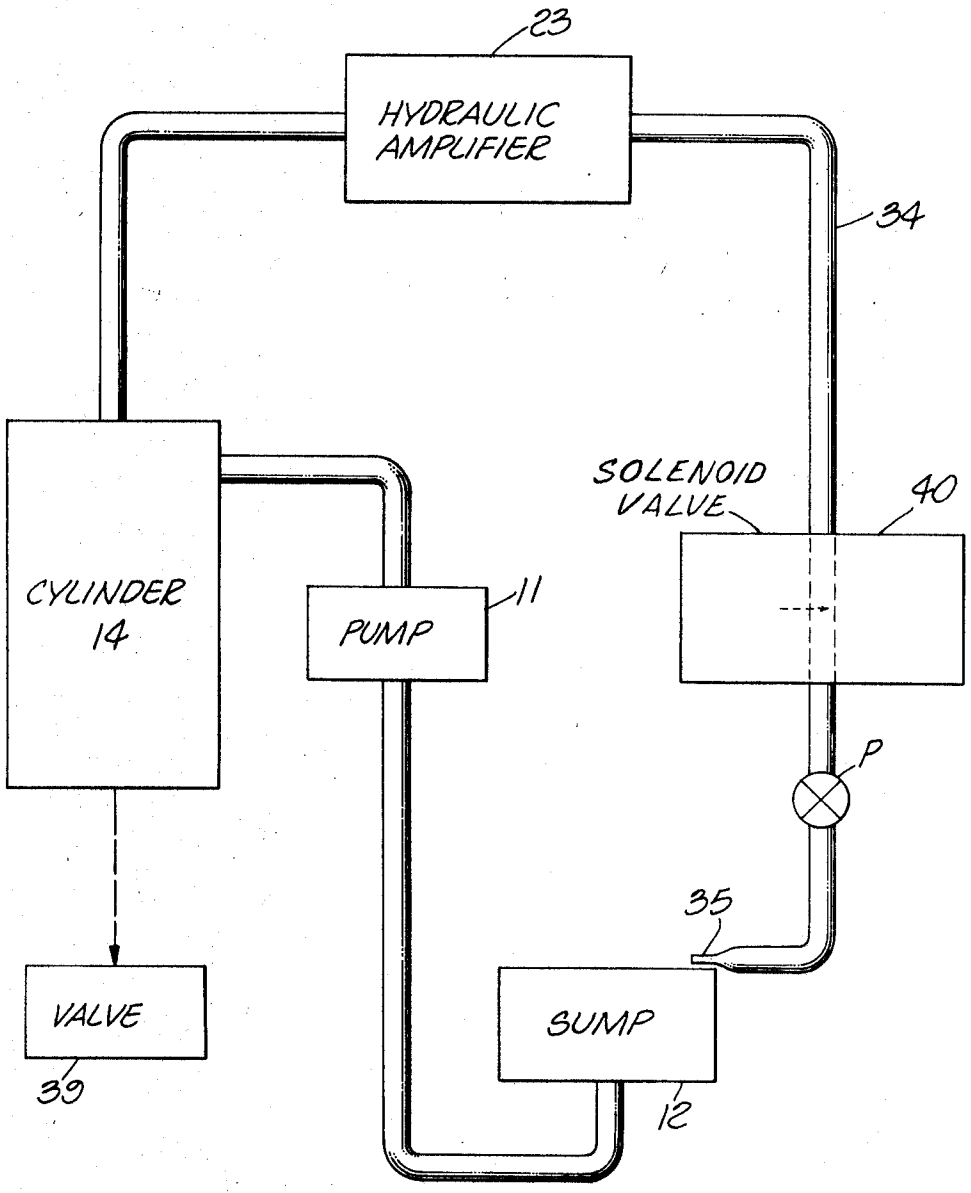


FIG. 2.

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United States Patent Office 3,516,332 Patented June 23, 1970

3,516,332

HYDRAULIC SYSTEM

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Filed June 17, 1968, Ser. No. 737,773
Int. Cl. F15b 9/03, 9/09, 13/043
U.S. Cl. 91—48 3 Claims

ABSTRACT OF THE DISCLOSURE

A solenoid valve-operated, restricted orifice for a hydraulic system, including a hydraulic amplifier to cause slow de-actuation of the controlled device. The orifice at the output of the hydraulic amplifier may, thus, control an enormously larger force, and a very small solenoid valve may turn the system on and off.

BACKGROUND OF THE INVENTION

This invention relates to fluid pressure control devices, and more particularly to a hydraulic system for controlling the position of a large valve or the like.

In the past it has been the practice to control valves by use of hydraulic systems such as that disclosed in U.S. Pat. No. 3,087,471. These systems, however, do not have means to close large valves slowly and automatically.

SUMMARY OF THE INVENTION

In accordance with the device of the present invention, the above-described and other disadvantages of the prior art are overcome by providing a hydraulic system including a fluid pressure responsive device, motive power means for supplying a hydraulic fluid under pressure to the device, and a hydraulic amplifier having an input conduit from the motive power means, and an output conduit. In accordance with the invention, a fixed restricted orifice is provided with a valve connected between the output conduit of the amplifier and the orifice. The valve is movable to a position for increasing the pressure of the fluid supplied from the amplifier to actuate the amplifier. The valve is also movable to an open position to allow the pressure of the fluid in the output conduit to decrease slowly as the fluid escapes from the orifice. The fluid pressure responsive device may be a valve. In this case, the valve is closed slowly.

The above-described and other advantages of the present invention will be better understood from the following description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a diagrammatic view of a hydraulic system constructed in accordance with the present invention; and

FIG. 2 is a block diagram illustrating an alternative embodiment of the invention:

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing in FIG. 1, one embodiment of the invention is indicated at **10**, having a sump **11** connected from sump **12** to an input conduit **13** of device **14** to be controlled. Device **14** comprises a housing including an upper portion **15** and a lower portion **16**. Upper portion **15** has a control conduit **17** connected thereto. Portion **16** has a vent port **18** therethrough. Device **14** has a piston **19** therein sealed by an O-ring **20**. Piston **19** has a rod **21** fixed thereto slideable in a bore **22** in housing

portion **16**. Control conduit **17** is connected to a hydraulic amplifier **23**, having a ball valve **24**. An arm **25** is pivoted at a pin **26** to a bracket **27**. Arm **25** assumes a position dependent upon the pressure in a chamber **28** inside amplifier **23**. The outside of amplifier **23** is open to the atmosphere or reservoir pressure. A spring **29** urges a flexible diaphragm **30** into chamber **28** by a back-up plate **31**. Diaphragm **30** and plate **31** are connected to arm **25** by a rod **32** pinned to arm **25** at **33**. The output conduit **34** of amplifier **23** is connected alternately to either one of two bleed orifices **35** and **36** by a three-way solenoid valve **37**.

The fluid output of orifice **36** is controlled by a system **38** that is identical to that disclosed in U.S. Pat. No. 3,087,471. System **38** includes a vane or flapper valve **50** which opens and closes orifice **36**. Valve **50** is pivoted at **51** from fixed member **52**. Valve **50** is fixed with a ferromagnetic beam **53** which is attracted by electromagnets **54** and **55**. One end of each electromagnets **54** and **55** is connected across a winding **56** of a potentiometer **57** having a wiper **58** movable with rod **21**. The other ends of electromagnets **54** and **55** are connected across a winding **59** of potentiometer **60** having a wiper **61** manually setable thereon. An AC source of potential **62** is electrically connected between wipers **58** and **61**.

In the operation of the embodiment of the invention shown in FIG. 1, upward vertical movement of piston **19** is produced by a coiled spring **63**, i.e., if the pressure above piston **19** is sufficiently low.

The entire structure shown in FIG. 1 may be identical to that disclosed, for example, in FIG. 5 of the said patent, except that conduit **34** may be directly connected to orifice **36**, and valve **37**, a valve P, and orifice **35** would be omitted. In the mode of operation herein, valve **37** provides free and open communication between conduit **34** and orifice **36**. The operation of the apparatus is identical to that disclosed in the said patent. For example, the position of wiper **61** may be manually adjusted to cause piston **19** to move downwardly as viewed in FIG. 1. In this case, orifice **36** will be closed off in proportion to the setting of wiper **61** or all the way. As stated previously, a three-way valve is in a position that conduit **34** has free and open communication with orifice **36**. Pressure will thus build up behind orifice **36** and conduit **34** and in chamber **28**. The increase in pressure in chamber **28** will cause spring **29** to compress. Diaphragm **30** will then lift and close off ball valve **24**. The bleed through ball valve **24** being cut off, pump **11** will begin to increase the pressure in device **14** above piston **19**. The piston **19** will then be driven downwardly. The feedback from rod **21** to wiper **28** will eventually rebalance the system to a particular setting of vave **39**. Rebalance will occur at a setting of valve **39** corresponding to the setting of wiper **61**. A change in the position of wiper **61** will cause a corresponding change in a similar manner in the setting of valve **39**.

If wiper **61** simply sets piston **19** further downwardly, the operation is identical to that just described. If the setting of wiper **61** tends to relieve the pressure above piston **19**, such relief is provided as follows. Flapper valve **50** opens orifice **36** wider. The pressure then in conduit **34** and chamber **28** declines. Spring **29** then presses diaphragm **30** downwardly, and valve **24** is opened wider. The bleed from pump **11** is thus increased and the pressure above piston **19** reduced. The piston **19** therefore will rise responsive to the pressure of spring **63**.

The foregoing is a description of the operation of the apparatus shown in FIG. 1 when valve **37** connects conduit **34** with orifice **36**. In this case, conduit **34** is not connected to valve P or orifice **35**.

The second mode of operation of the invention is effected by closing off conduit **34** from orifice **36** by the use of valve **37**, and by connecting conduit **34** to valve P and orifice **35**. Let us assume this condition. Let us further assume that valve **39** is closed when piston **19** is in the position shown in FIG. 1. If valve **37** connects conduit **34** to valve P and orifice **35** while piston **19** is in the position shown, nothing happens. The pressure above piston **19** is bled off through orifice **35**, but the pressure is already insufficient to open valve **39**. On the other hand, if piston **19** is spaced downwardly from the position shown in FIG. 1, bleeding the pressure above piston **19** off through orifice **35** will cause valve **39** to close slowly. This is true because the hydraulic fluid is substantially incompressable. So long as pump **11** is operating, piston **19** must be maintained stationary or moved downwardly unless sufficient fluid is bled off from the top of piston **19**. However, if this fluid is bled off to fast, valve **39** will close rapidly. Fluid is bled off in accordance with the device of the present invention at orifice **35**. As before, this reduces the pressure in conduit **34** and chamber **28**. Spring **29** then moves diaphragm **30** downwardly and opens valve **24**. Fluid is thus bled off from the top of piston **19** through conduit **17**.

An identical system is shown in FIG. 2, except that system **38** and orifice **36** are omitted. Further, a solenoid valve **40** replaces solenoid valve **37**. In the operation of the embodiment of FIG. 2, solenoid valve **40** simply closes off conduit **34** and closes valve **39**. When solenoid valve **40** opens, valve **39** slowly closes as the pressure inside amplifier **23** is bled off slowly through orifice **35**.

In accordance with the foregoing, a large opening force and closing force may be controlled by small solenoid valves **37** and **40**. Moreover, valve **39** can be controlled to close slowly simply by the use of the bleed orifice **35**.

An adjustable valve "P" is employed ahead of orifice **35** to adjust the effectiveness of orifice **35**.

What is claimed is:

1. A hydraulic system comprising: a fluid pressure responsive device; motive power means for supplying a hydraulic fluid under pressure to said device; a hydraulic amplifier having an input conduit from said motive power means and an output conduit; a fixed restricted orifice; a main valve connected between said output conduit and said orifice in a position to allow fluid flow from said output conduit to flow through said orifice, said main valve being movable to a position for increasing the pressure of the fluid supplied from said amplifier to actuate the chamber connected between its input and output conduits, an auxiliary valve at the input conduit to throttle flow therefrom into said chamber, and means responsive to the pressure in said chamber to close said auxiliary valve an incremental amount each time the pressure in said chamber increases an incremental amount.

2. The invention as defined in claim **3**, wherein said main valve is a three-way valve connected to an additional orifice, said motive power means including control means with a flapper valve to press against the fluid emanating from said additional orifice to control the position of said pressure responsive device.

3. The invention as defined in claim **1**, wherein a manually adjustable valve is positioned between said main valve and said orifice.

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PAUL E. MASLOUSKY, Primary Examiner

U.S. Cl. X.R.

91—363, 446, 461