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HYDRAULIC CONTROL SYSTEM

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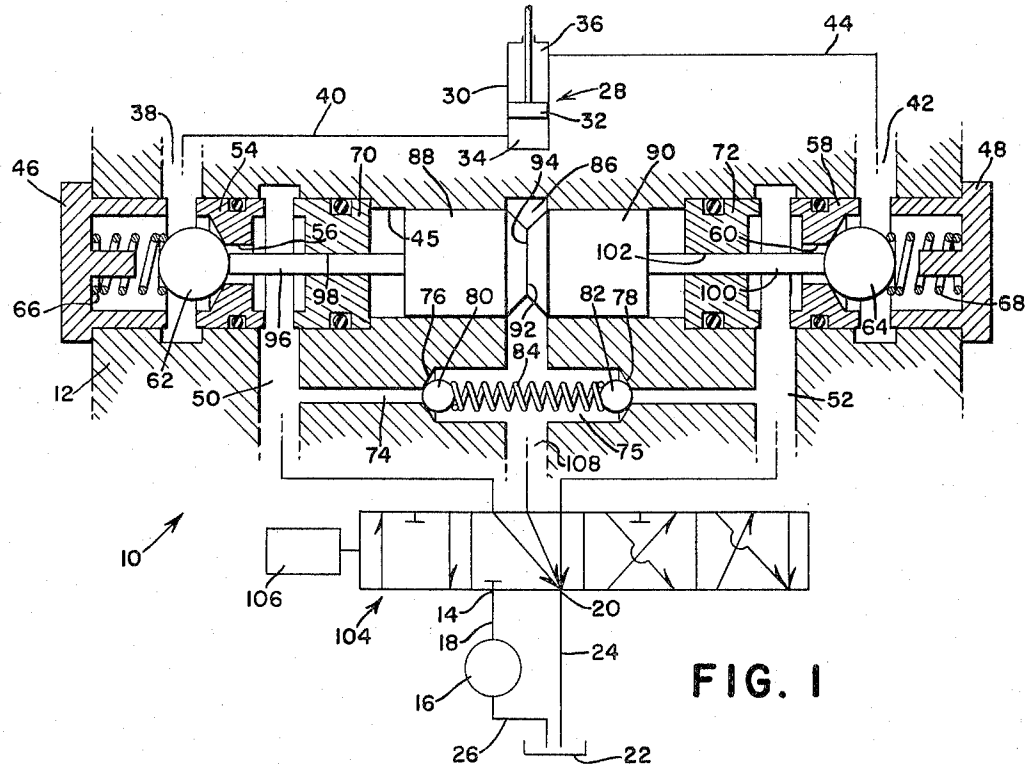

FIG. 1

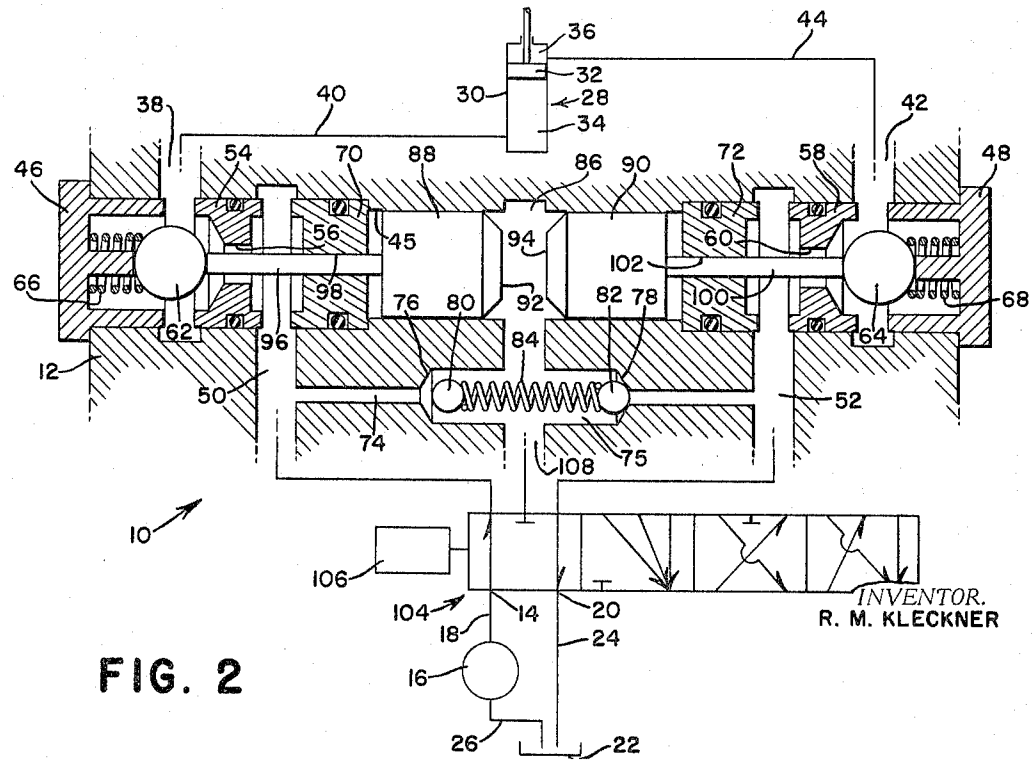

FIG. 2

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HYDRAULIC CONTROL SYSTEM

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This invention relates to a hydraulic control system and more particularly to a hydraulic control system improved hydraulically actuated check valves for interrupting the return of fluid from a pressure actuated motor.

In certain hydraulic systems having a fluid pressure source and a reversible pressure actuated motor, such as a two-way hydraulic cylinder, it is known to provide check valves to prevent the return of fluid from the pressurized side of the motor so that the motor will maintain its position. It is also known to provide hydraulically actuated means to selectively open the check valves to permit the exhaust of fluid from the exhaust side of the motor only. The hydraulic means for opening the check valves have conventionally been hydraulically actuated pistons which respond to pressure in the pressurized side of the system to engage and unseat the check valves in the exhaust side of the system, the check valve in the pressurized side of the system being opened by the pressure differential between the pressure source and the motor. However, in many applications, such as in a two-way hydraulic cylinder utilized to position a ground working implement on an agricultural tractor, pressure fluctuations in the system or load reversal caused intermittent opening and reseating of the check valve in the exhaust side of the system, producing vibration or "chatter" in the valve.

According to the present invention, a control valve assembly is provided for such a system which includes means for positively opening both check valves when pressure is being supplied to the motor, preventing the reseating of the check valve on both the exhaust and pressurized side of the motor and thereby eliminating valve "chatter."

A more specific object is to provide such a hydraulic control valve assembly with a pair of pistons responsive to fluid pressure on either side of the system to respectively engage and unseat both check valves, and further to provide means for supplying the fluid pressure from the pressurized side of the system to both pistons and including a second pair of check valves, one of which opens in response to pressure in the pressurized side of the system to supply fluid to the pistons, the other of which prevents the escape of pressure to the exhaust side of the system.

Still another object is to provide such a control valve assembly which is compact and simple and inexpensive to manufacture.

These and other objects will become apparent from the following detailed description and accompanying drawings wherein:

FIG. 1 is a combined sectional and schematic view of the hydraulic system in a neutral condition, showing the check valve portion in section and schematically showing the remainder of the system.

FIG. 2 is a view similar to FIG. 1, but with the system positioned for supplying fluid under pressure to one side of the hydraulic motor.

The hydraulic system includes a control valve assembly, indicated in its entirety by the numeral 10, and including a valve body 12, part of which is shown in section, the remainder being schematically shown. The body 12 has an inlet port 14, connected to a source of fluid pressure 16 via a conduit 18, and an exhaust port 20, connected to a reservoir 22 via a conduit 24, fluid being

supplied to the pressure source 16 from the reservoir 22 via a conduit 26.

A reversible hydraulic motor 28, here shown as a double-acting hydraulic cylinder or ram, includes a cylinder 30 and a piston 32 movable in the cylinder 30 in response to a pressure differential between the opposite ends 34 and 36 of the cylinder.

One end 34 of the cylinder is connected to a first motor outlet passage 38 in the body 12 by a conduit 40, and the other end 36 of the cylinder is connected to a second motor outlet 42 in the body 12 by a conduit 44.

The first and second motor outlet passages 38 and 42 are intersected by a cylindrical bore 45, extending through the body 12 and closed at opposite ends by end caps 46 and 48 respectively. The bore 45 is also intersected between the first and second motor outlet passages 38 and 42 by first and second passages 50 and 52 in the body 12. A first valve seat 54, having an axial orifice 56, is mounted in the bore 45 between the first motor outlet passage 38 and the first passage 50 and a second valve seat 58, having an axial orifice 60, is similarly mounted in the bore 45 between the second motor outlet passage 42 and the second passage 52. The first motor outlet passage 38, the first passage 50, and the valve seat 54 between said passages form a first passage means or conduit means through the body 12 closable by a spherical check valve 62 biased against the valve seat 54 over the orifice 56 by a spring 66 acting between the end cap 46 and the check valve 62 for preventing the return of fluid from the motor outlet passage 38 to the first passage 50. Similarly, the second motor outlet passage 42, the second passage 52, and the valve seat 58 between said passages form a second passage or conduit means through the body 12, closable by a check valve 64 biased against the valve seat 58 over the orifice 60 by a spring 68 acting between the valve 64 and the end cap 48 for preventing the return of fluid from the second motor outlet passage 42 to the second passage 52.

The bore 45 is closed between the first and second passages 50 and 52 by a pair of cylindrical members 70 and 72 mounted in the bore adjacent the passages 50 and 52 respectively. A third or pilot passage 74 extends between the first and second passages 50 and 52 and has a cylindrical central portion 75 with a greater diameter than the remainder of the passage 74, the opposite ends of the central portion 75 forming valve seats 76 and 78 respectively closable by spherical check valves 80 and 82 biased in opposite directions by an intermediate compression spring 84 toward a closed position, preventing the return of fluid from the central portion 75 to either passage 50 or 52. The central portion 75 is connected to the bore 45 between the members 70 and 72 via a third passage arm 86.

A pair of pistons 88 and 90, respectively having opposite end faces 92 and 94, are mounted in the bore 45 on opposite sides of the third passage arm 86. The piston 88 includes a shaft 96 of reduced diameter extending through a bore 98 in the member 70 and the orifice 56 in the valve seat 54, the terminal end of the shaft 96 being engageable with the valve 62 to unseat the valve in response to axial movement of the piston 88. Similarly, the piston 90 includes a shaft portion 100 of reduced diameter extending through a bore 102 in the member 72 and the orifice 60 in the valve seat 58, the terminal end of the shaft portion 100 being engageable with the valve 64 to unseat the valve in response to axial movement of the piston 90. The bore 45 is vented to the reservoir 22 between the piston 88 and the member 70 and between the piston 90 and the member 72 by conventional conduit means (not shown) to permit movement of the pistons.

A spool-type control valve means 104, shown schematically in the drawings, is axially shiftable via an actu-

ating means **106** to selectively establish different connections between the inlet and exhaust ports **14** and **20** and the first, second, and third passages **50**, **52**, and **74**, the central portion **75** of the third passage **74** being connected to the control valve means **104** via a third passage arm **108**.

In operation, when the control valve **104** is in neutral position, as shown in FIG. 1, the inlet **14** is blocked and the first and second passages **50** and **52** and the central portion **75** of the third passage **74** are connected to the reservoir **22** via the exhaust port **20**. Since there is no fluid pressure in the passages **50**, **52**, or **74**, no force is exerted on either piston **88** or **90** or check valve **62** or **64**, and the springs **66** and **68** maintain the check valves **62** and **64** in a closed position, preventing the flow of fluid from either end **34** or **36** of the cylinder **30** whereby the piston **32** maintains its position on the cylinder **30**.

When the valve **104** is moved to its "raise" position, as shown in FIG. 2, the inlet port **14** is connected to the first passage **50**, the third passage arm **108** is blocked, and the second passage **52** is connected to the exhaust port **20**. The fluid pressure in the passage **50** opens the check valve **62** against the bias of the spring **66**, supplying fluid under pressure to the lower end **34** of the cylinder **30**. The pressure in the passage **50** also opens the check valve **80** against the bias of the spring **84**, supplying fluid under pressure to the central portion **75** of the third passage **74** and consequently to the bore **45** between the pistons **88** and **90**. This fluid pressure exerts a force on the pistons **88** and **90**, moving the pistons in opposite directions, the shaft **100** of the piston **90** engaging and unseating the check valve **64** to permit the exhaust of fluid from the upper end **36** of the cylinder **30** via the conduit **44**, the motor outlet passage **42**, the orifice **60**, and the second passage **52**. Similarly, the shaft **96** of the piston **88** engages the valve **62** to maintain it in its unseated position. When the pistons **88** and **90** reach their value opening positions shown in FIG. 2, the flow of fluid into the third passage **74** ceases, and the check valve **80** reseats, the check valves **80** and **82** preventing the exhaust of fluid from the central portion **75** of the third passage **74** to maintain the pistons **88** and **90** in their valve opening positions until the valve **104** is returned to its neutral position. Since the pressure in the central portion **75** is not affected by pressure drops in the passage **50** after the check valve **80** reseats, the pistons will maintain the check valves **62** and **64** in their open conditions regardless of pressure fluctuation or load reversals in the system, preventing vibration or intermittent seating and unseating of the check valves, particularly the check valve **64** on the exhaust side of the system which has heretofore been subject to vibration under load reversal conditions.

It can be appreciated that when the control valve **104** is moved to the left from its neutral position in FIG. 1 to the adjacent position, a similar condition is obtained. The inlet port **14** is connected to the second passage **52**, the third passage arm **108** is blocked, and the first passage **50** is connected to the exhaust port **20**. The pressure in the second passage **52** opens the check valve **64** and the check valve **82** supplying fluid under pressure to the upper end **36** of the cylinder **30** and to the central portion **75** of the third passage **74**, again actuating the pistons **88** and **90** in opposite directions to unseat the check valves **62** and **64** and maintain the check valves in their unseated position.

By moving the control valve **104** to its extreme position to the left, a "float" condition of the system is obtained wherein the first and second passages **50** and **52** are connected to the exhaust port **20** and the third passage arm **108**, and consequently the central portion **75**, is connected to the inlet port **14**, the fluid pressure in the central portion **75** maintaining the check valves **80** and **82** in a closed position and actuating the pistons **88** and **90** to unseat the check valves **62** and **64**, permitting the exhaust of fluid from both ends **34** and **36** of the cylinder **30**.

Other features and advantages of the present invention will readily occur to those skilled in the art, as will many modifications and alterations in the preferred embodiment of the invention described herein, all of which may be achieved without departing from the spirit and the scope of the invention.

What is claimed is:

1. A hydraulic system comprising: a source of fluid pressure; a hydraulic motor having alternate inlets; a first and second conduit means respectively connected to said alternate inlets; a control valve means operatively connected to the source of fluid pressure and to said first and second conduit means for selectively supplying fluid under pressure to said conduit means; a first and second check valve respectively mounted in said first and second conduit means between the control valve means and the motor and biased against return of fluid from said motor; a third conduit means interconnecting the first and second conduit means between the control valve means and the first and second check valves respectively; a pair of check valves operably mounted in said third conduit means for preventing the flow of fluid from the third conduit means to the first and second conduit means respectively; and hydraulic means actuated by fluid pressure between the check valves in the third conduit means to unseat the first and second check valves.

2. The invention defined in claim **1** wherein the hydraulic means includes a pair of cylinders in fluid communication with said third conduit means between the check valves in said third conduit means and a pair of pistons respectively mounted in said cylinders for movement in response to fluid pressure therein to respectively engage and unseat said first and second check valves.

3. The invention defined in claim **2** wherein said cylinders are coaxially joined and said pistons are coaxially opposed in said cylinders, the third conduit means being connected to the cylinders between said opposed pistons.

4. A hydraulic system comprising: a source of fluid pressure having an associated reservoir; a reversible hydraulic motor having alternate inlets; a first and second conduit means respectively communicating with said alternate inlets; a third conduit means; control valve means operably connected to said pressure source, reservoir, and first, second, and third conduit means for establishing a neutral condition wherein all three conduit means are connected to said reservoir, a first condition wherein the first conduit means is connected to the fluid pressure source and the second conduit means is connected to the reservoir, and a second condition wherein the second conduit means is connected to the fluid pressure source and the first conduit means is connected to the reservoir; first and second check valves respectively mounted in the first and second conduit means between the control valve means and the motor and biased against the return of fluid from the motor, said third conduit means being in fluid communication with the first and second conduit means between the control valve means and the respective first and second check valves; a pair of check valves in said third conduit means for respectively preventing the flow of fluid from the third conduit means to the first or second conduit means, said control valve means being connected to said third conduit means between said third conduit check valves; and hydraulic means actuated by fluid pressure between said third conduit check valves to operably engage and unseat said first and second check valves.

5. The invention defined in claim **4** wherein the hydraulic means includes a pair of cylinders in fluid communication with said third conduit means between the check valves and a pair of pistons respectively mounted in said cylinders for movement in response to fluid pressure in said cylinders to respectively engage and unseat said first and second check valves.

6. A hydraulic control valve assembly for controlling the flow of fluid between a source of fluid pressure and a hydraulic motor having alternate inlet means comprising: a valve body; a first and second passage means in the body respectively connected to the alternate motor inlet means; a third passage means in said body interconnecting the first and second passage means; a first and a second check valve respectively mounted in the first and second passage means between the motor and the third passage means and biased against the return of fluid from the motor; a pair of opposite check valves in the third passage means respectively biased against the flow of fluid from the third passage means into the first and second passage means; a control valve means operably connected to the first and second passage means on the same side of the respective first and second check valves as the third passage means and connected to the third passage means between the third passage means check valves for selectively exhausting or pressurizing the first, second, or third passage means; and hydraulic motor means operably connected to and actuated by fluid pressure in the third passage means between the check valves to engage and unseat the first and second check valves.

7. A hydraulic control valve assembly for controlling the flow of fluid between a source of fluid pressure having an associated reservoir and a hydraulic motor having alternate inlet means comprising: a valve body; a first and a second passage means in the body respectively connected to the alternate motor inlet means; a third passage means in the body; a control valve means for selectively connecting the first, second, or third passage means to the pressure source or reservoir; a first and a second check valve respectively mounted in the first and second passage means between the control valve means and the motor and biased against return of fluid from the motor, the third passage means interconnecting the first and second passage means on the control valve side of said check valves; a pair of opposite check valves in the third passage means biased against the return of fluid to

the first or second passage means; a bore in said valve body; and a pair of pistons mounted in said bore, the portion of the bore between the pistons being in fluid communication with the third passage means between the check valves, the control valve means also being connected to the third passage means between the check valves, said pistons being axially slidable in response to fluid pressure in said bore between the pistons to respectively engage and unseat said first and second check valves.

8. A hydraulic system comprising: a source of fluid pressure; a hydraulic motor; a first conduit means connected to said hydraulic motor; a control valve means operatively connected to the first conduit means and the source of fluid pressure for selectively pressurizing or exhausting said first conduit means; a first check valve means in said first conduit means between the control valve means and the motor, biased against the return of fluid from said motor; a hydraulic cylinder including piston means movable in response to hydraulic pressure in said cylinder to operably engage and open said first check valve means; a pilot conduit means interconnecting said hydraulic cylinder and said first conduit means between said first check valve means and said control valve means; a second check valve means in said pilot conduit means biased against the return of fluid from said hydraulic cylinder; said control valve means also being operatively connected to said pilot conduit means between said second check valve means and said hydraulic cylinder to selectively pressurize or exhaust said hydraulic cylinder.

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