Jan. 4, 1955 K. F. WITT 2,698,517

AUTOMATIC MEANS TO CONTROL AND REVERSE FLUID-OPERATED CYLINDER-AND-PISTON UNITS

Filed May 21, 1952 3 Sheets-Sheet 1

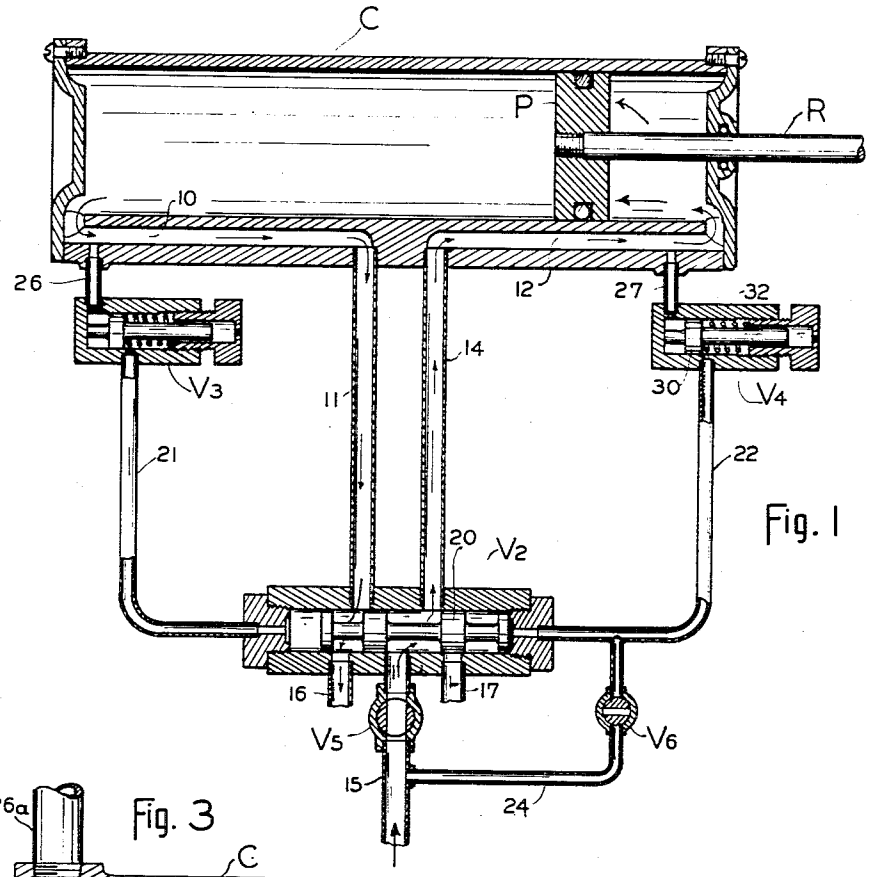


Fig. 1

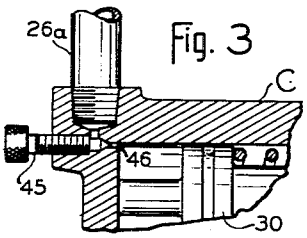


Fig. 3

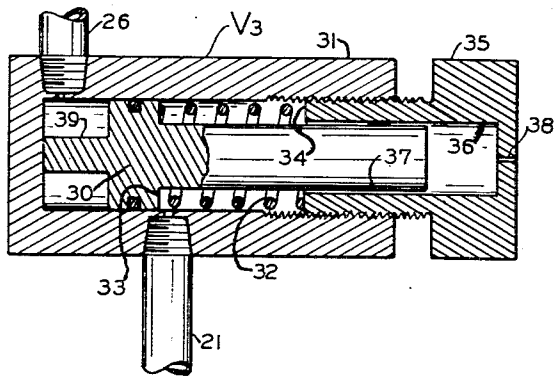


Fig. 2

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Fig. 4

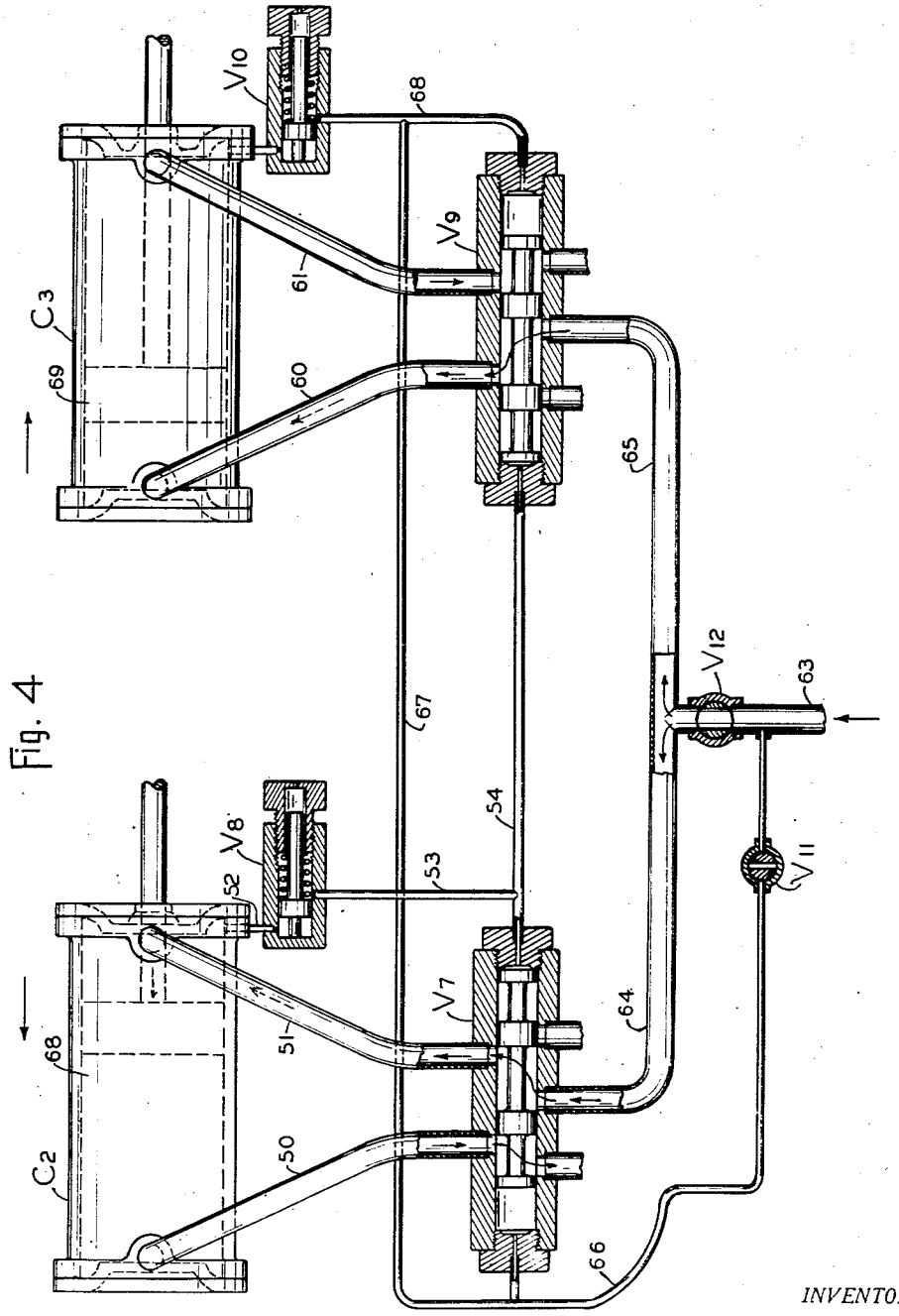


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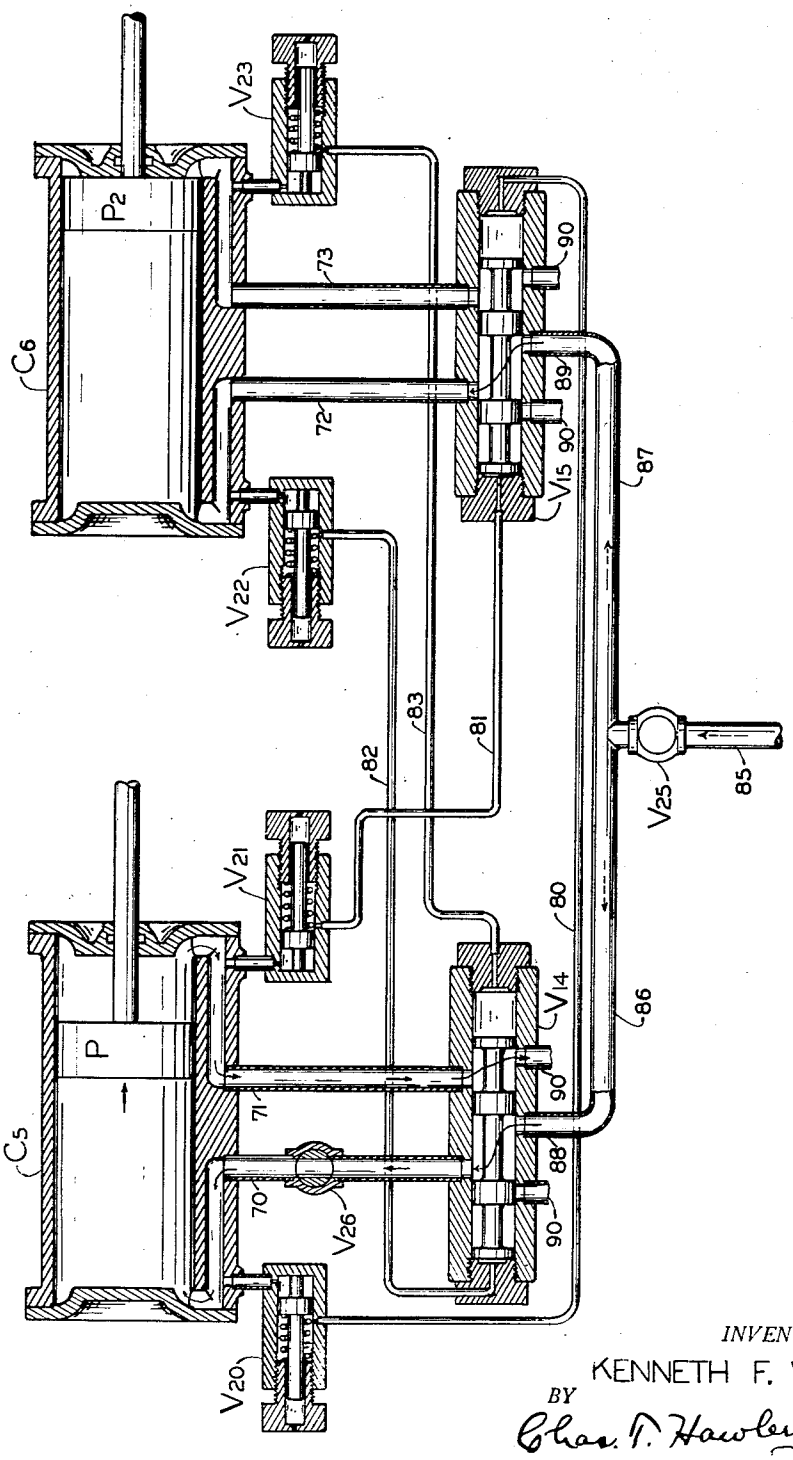
Fig. 5

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2,698,517

# AUTOMATIC MEANS TO CONTROL AND REVERSE FLUID-OPERATED CYLINDER-AND-PISTON UNITS

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1 Claim. (Cl. 60—97)

This invention relates to fluid-operated cylinder-and-piston units and to the automatic control and reversal thereof.

It is the general object of the present invention to provide means controlled by the pressure in the active cylinder and effective to reverse the main valve at the completion of a piston stroke in either direction.

I also provide means to control the operation of two cylinder-and-piston units simultaneously, but with the pistons moving in opposite directions. A construction is also shown in which two controlled pistons operate successively and in the same direction.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claim.

A preferred form of the invention is shown in the drawings, in which

Fig. 1 is a sectional plan view of certain fluid-operated mechanism involving my invention;

Fig. 2 is a sectional elevation of my improved control valve;

Fig. 3 is a fragmentary sectional elevation showing a slight modification to be described;

Fig. 4 is a plan view, partly in section, of a duplex mechanism, with the fluid-operated pistons moving simultaneously in opposite directions; and

Fig. 5 is a view similar to Fig. 4 but showing a pair of pistons arranged for successive operation in the same direction.

Referring particularly to Figs. 1 and 2, I have shown a power unit comprising a main cylinder C having a piston P slidable therein and connected to a piston rod R by which any desired moving parts may be actuated. The head end of the cylinder C is connected by a passage **10** and pipe **11** to a main valve V2, and the rod end of the cylinder C is similarly connected by a passage **12** and pipe **14** to the same valve V2.

Fluid under pressure is supplied to the valve V2 through a pipe **15**, and the valve V2 is provided with exhaust passages **16** and **17**. A four-part piston or spool **20** is freely slidable in the valve V2, and the valve is connected at its ends through pipes **21** and **22** to special control valves V3 and V4. A start-and-stop or shut-off valve V5 is supplied in the pipe **15**, and a valve V6 in a by-pass **24** is provided for a purpose to be described.

The control valve V3 is shown in detail in Fig. 2 and is connected to the passage **10** in the cylinder C by a short pipe **26**. The valve V4 is of identical construction and is connected to the passage **12** by a pipe **27**.

The valve V3 comprises a piston **30** slidable in a cylinder **31** and normally held in the left-hand position shown in Fig. 2 by a compression spring **32**, which is interposed between a shoulder **33** of the piston **30** and a shoulder **34** at the inner end of an adjusting screw **35**. The screw **35** is threaded in the cylinder **31** and may be turned in or out to vary the compression of the spring **32**.

The screw **35** has an axial recess **36** to loosely receive the piston rod **37**, and the recess has a vent **38** to relieve the pressure therein. At its left-hand end, the piston **30** has an axial projection **39** which serves as a stop and which checks the piston **30** in the position shown in Fig. 2.

With the associated parts in the position shown in Fig. 1, fluid under pressure from the supply pipe **15** will flow through the pipe **14** and passage **12** to the right-hand or rod end of the cylinder C will move the piston P to the left.



The tension of the spring **32** in the valve V4 is sufficient to prevent the piston **30** in said valve from being moved to the right so long as the piston P is free to move to the left in the cylinder C.

When the piston P reaches its limit of travel, however, as by engagement with the end of the cylinder, the fluid pressure will then build up in the right-hand end of the cylinder C and in the passage **12** and will eventually overcome the spring **32** and force the piston **30** to the right to uncover the pipe **22**.

Strong pressure will then be applied through the pipe **22** to the main valve V2 and will shift the piston or spool **20** to its extreme left-hand position, thus reversing the main valve and the supply and exhaust connections of the main cylinder C and causing the main piston P to begin its travel to the right.

When the right-hand limit of travel is reached, pressure will build up in the left-hand end of the cylinder C and the valve V3 will thereupon be opened to supply pressure through the pipe **21** to again reverse the piston **20** and the main valve V2.

The piston P will thus be reciprocated between its defined limits of travel in both directions, and the direction of travel will be automatically reversed at the end of each stroke through the operation of the control valves V3 and V4 and without reliance on reversing dogs or other mechanical or electrical devices.

The only moving control parts are the pistons **30** in the valves V3 and V4, and these movements take place in one direction on the application of relatively heavy pressure through one of the pipes **26** or **27**, and take place in the opposite direction as soon as the pressure in the associated pipe **26** or **27** is relieved. The entire operation is extremely reliable and satisfactory.

In Fig. 3, I have shown a needle valve **45** interposed in a small passage **46** connecting the pipe **26***a* to the cylinder C'. This needle valve may be adjusted as desired to control the speed of operation of the piston **30** in the associated valve V3 or V4.

The valve V6 in the bypass **24** may be opened manually to shift the main valve piston **20** to the left at any time and to thus apply pressure in the head end of the cylinder. If the valves V5 and V6 are both closed, all operations cease.

In the duplex construction shown in Fig. 4, two main cylinders C2 and C3 are provided. The cylinder C2 is connected by pipes **50** and **51** to a main valve V7 corresponding in all respects to the main valve V2 shown in Fig. 1. The right-hand or rod end of the cylinder C2 is connected to the main valve through a pressure-responsive control valve V8 which is identical with the valve V3 shown in Fig. 2. The valve V8 is connected to the cylinder C2 by a pipe **52** and is connected by a pipe **53** to a pipe **54** which connects the adjacent ends of the main valve V7 and a second main valve V9.

The cylinder C3 is connected by pipes **60** and **61** to said main valve V9, which valve is of the same construction as the main valve V7 (Fig. 4) and the main valve V2 (Fig. 1). Fluid under pressure is supplied through a main supply pipe **63** and branch pipes **64** and **65**.

A by-pass pipe **66** is connected into the left-hand end of the main valve V7 and is also connected through a cross pipe **67** to a pipe **68** which extends from a control valve V10 for the cylinder C3 to the right-hand end of the main valve V9.

A manual shut-off valve V11 is provided in the by-pass pipe **66**, and a shut-off valve V12 is provided in the pipe **63** between the by-pass pipe **66** and the branch pipes **64** and **65**.

In this duplex machine, the pistons **68** and **69** in the cylinders C2 and C3 are operated simultaneously but in opposite directions. Consequently, the piston of either cylinder may perform a working stroke while the piston of the opposite cylinder is performing a return stroke.

By momentarily opening the by-pass valve V11, the main valves V7 and V9 may be placed in the positions shown in Fig. 4. If the valve V12 is then opened, fluid under pressure will flow to the right-hand end of the cylinder C2 and to the left-hand end of the cylinder C3.

The piston **68** will then move to the left and the piston **69** to the right until the pistons reach the ends of their

respective strokes, whereupon pressures will be built up in the control valve V8, and the slidable pistons in the main valves V7 and V9 will be shifted to the left and to the right respectively, to reverse the operating connections of the main cylinders C2 and C3.

It will be noted that the cross pipe 54 connects the adjacent ends of the valves V7 and V9, while the cross pipe 67 similarly connects the outside ends. Consequently, when the piston 68 completes its stroke to the left and pressure builds up in the right-hand end of the cylinder C2, the control valve V8 will operate to admit pressure to the pipes 53 and 54 and to thus shift the piston in the valve V7 to the left and the piston in the valve V9 to the right. The piston 68 will then begin a movement to the right and the piston 69 to the left, which movement will continue until pressure is built up in the right-hand end of the cylinder C3.

The valve V10 will then admit pressure to the pipes 68 and 67, thus again reversing the main valves V7 and V9, whereupon the described cycle of operations will start over.

The valve V11 may be manually opened at any time to place the main valves V7 and V9 in the positions shown, and the valve V12 may be closed at any time to stop all further operations of the duplex machine.

In the duplex construction shown in Fig. 5, two main cylinders C5 and C6 are provided. The cylinder C5 is connected by pipes 70 and 71 to a main valve V14 corresponding in all respects to the main valve V2 shown in Fig. 1. The cylinder C6 is similarly connected by pipes 72 and 73 to a main valve V15. Pressure-responsive valves V20 to V23 are provided at the opposite ends of the cylinders C5 and C6 as shown.

The valve V20 at the closed end of the cylinder C5 is connected by a pipe 80 to the right-hand end of the main valve V15. The valve V21 at the rod end of the cylinder C5 is connected by a pipe 81 to the left-hand end of the main valve V15. The valve V22 at the left-hand or closed end of the cylinder C6 is connected by a pipe 82 to the left-hand end of the main valve V14, and the valve V23 at the right-hand or rod end of the cylinder C6 is connected by a pipe 83 to the right-hand end of the main valve V14.

Fluid under pressure is furnished through a supply pipe 85 and branch pipes 86 and 87 to the intakes 88 and 89 for the main valves V14 and V15 respectively. The usual exhaust connections 90 are also provided for the valves V14 and V15. A shut-off valve V25 is provided in the supply pipe 85, and a setting valve V26 is provided in the pipe 70.

Assuming that the parts are in the position shown in Fig. 5, the operation is as follows:

Fluid under pressure will be supplied through the supply pipe 85, branch pipe 86, intake 88 and pipe 70 to the left-hand or closed end of the cylinder C5, thus forcing the piston P to the right. When the piston has completed its right-hand stroke, pressure will be built up in the left-hand or closed end of the cylinder C5, which pressure will eventually overcome the valve V20 and will admit fluid under pressure through pipe 80 to the right-hand end of the main valve V15.

This will move the valve piston to the left and will admit fluid under pressure through the branch pipe 87, intake 89 and pipe 72 to the left-hand or closed end of the cylinder C6, thus moving the piston P2 to the right.

After this stroke is completed, pressure is built up to open the valve V22 and admit fluid under pressure through the pipe 82 to the left-hand end of the valve V14, thus forcing the valve piston to the right and admitting fluid under pressure through the pipe 71 to the right-hand or rod end of the cylinder C5 and thereupon shifting the piston P to the left.

When this stroke is completed, pressure will be built up in the rod end of the cylinder C5 to overcome the valve V21 and admit fluid under pressure through the pipe 81 to the left-hand end of the valve V15, thus moving the valve piston to the right and admitting fluid under pressure through the pipe 73 to the right-hand end of the cylinder C6, with resultant movement of the piston P2 to the left.

When this movement is completed, pressure will be built up to open the valve V23 and admit fluid under pressure through the pipe 83 to the right-hand end of the main valve V14, thus returning the valve piston to its original position. Both pistons P and P2 are then in their original or extreme left-hand positions, and the described cycle of operations will thereupon be repeated.

The setting valve V26 may be closed as soon as the piston P2 in the cylinder C6 completes its stroke to the left, thus holding both pistons P and P2 in their extreme left-hand or loading position for as long a period as may be desired. All operations may be stopped at any time by closing the shut-off valve V25.

I have thus provided improved automatic mechanism for controlling the movement and reversal of one or more cylinder-and-piston units entirely by cylinder pressures and without the use of dogs or other mechanical or electrical devices.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claim, but what I claim is:

In a fluid-operated mechanism, two cylinder-and-piston power units, a main valve for each power unit and having a cylinder with a reversing piston slidable therein, a pressure-responsive control valve for each end of each power-unit cylinder, and direct connections from each control valve of each power unit to one end of the main valve for the other power unit, whereby a substantial rise in pressure in either power-unit cylinder will act directly on the main valve for the other power-unit cylinder and will thereby shift said main valve and reverse said other power unit.

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