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STACKABLE ROTARY VALVES

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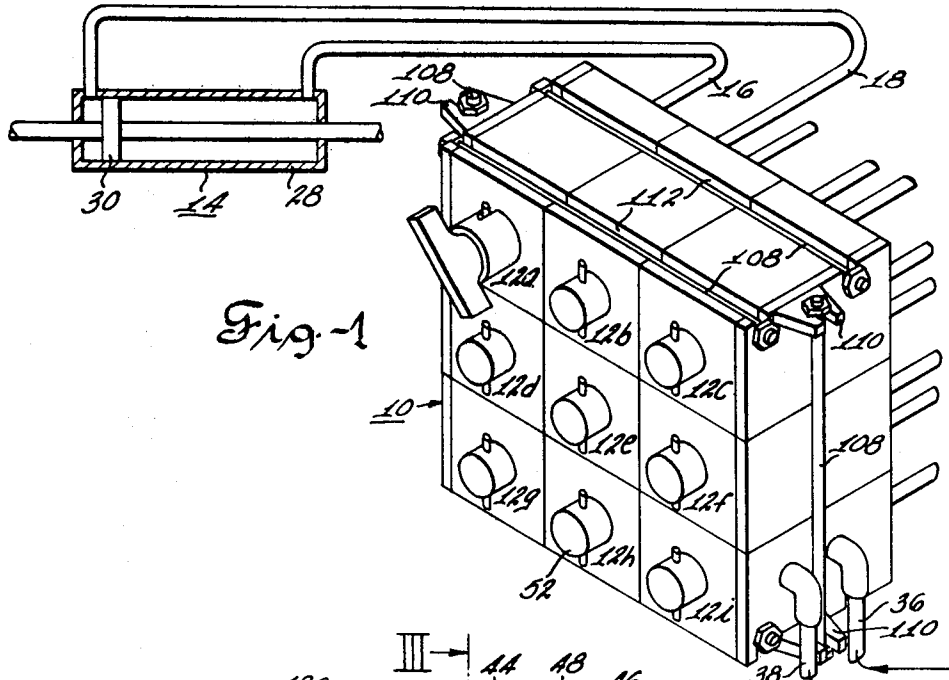


Fig. 1

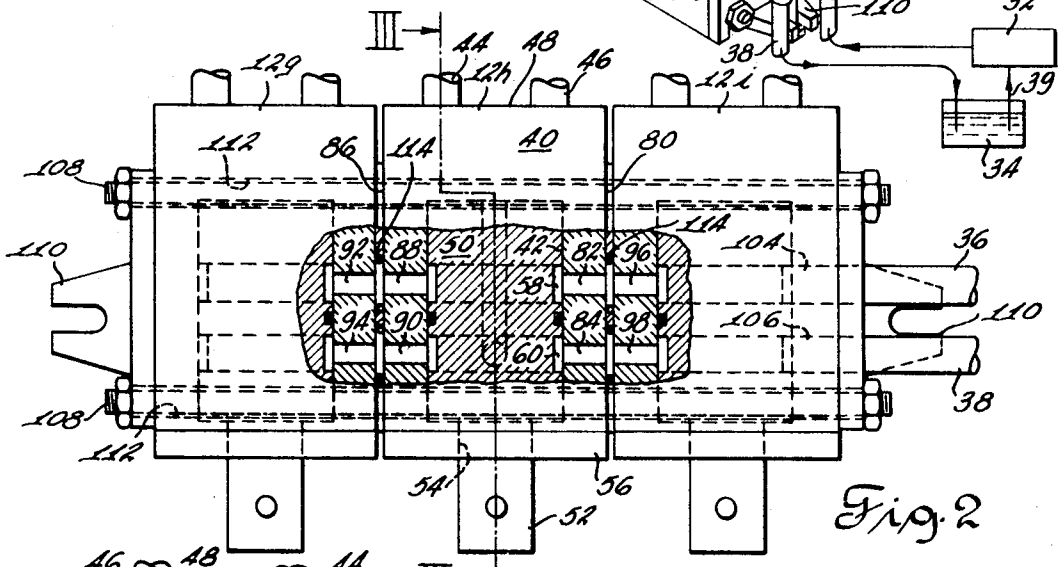


Fig. 2

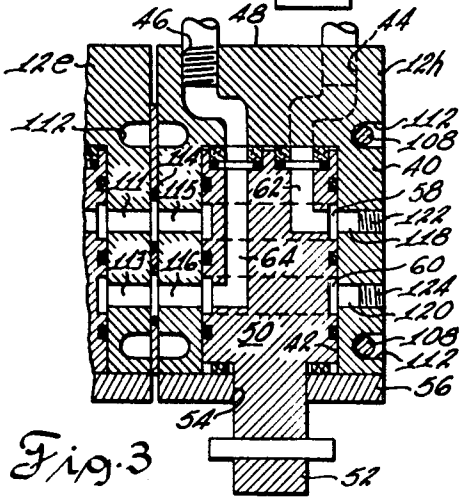


Fig. 3

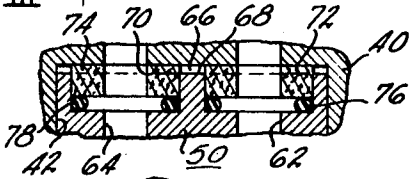


Fig. 4

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STACKABLE ROTARY VALVES

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ABSTRACT OF THE DISCLOSURE

A system for controlling a plurality of actuators operable from a source of pressurized fluid comprises a plurality of rotary valves, one valve for each actuator, designed to be stacked together in a compact unit or arrangement. Each valve comprises a body having a cavity in which a rotary cylindrical valve member is located. The valve member has two annular grooves therein, one of which is a fluid supply chamber and the other of which is a fluid return chamber. Each chamber is alternatively connectable through passages in the valve member to either of two actuator ports in the valve body. The actuator ports are connected to an actuator. The supply chamber and return chamber are also in communication with supply ports and return ports, respectively, provided in the valve body. When a plurality of valves are stacked and secured together, the supply ports and return ports of one valve body communicate with those of any adjacent valve body. Thus, it is only necessary to connect the supply port and return port of one valve body to the fluid source and fluid reservoir, respectively, to effect fluid supply and return for all valves in the stack, regardless of their number.

SUMMARY OF THE INVENTION

This invention relates generally to rotary valves and particularly to those which can be stacked together into a compact unit.

Known types of conventional rotary valves for controlling actuators typically comprise a valve body having four separate passages therein, two for connection to a fluid supply and a return reservoir and two for connection to a fluid responsive actuator. A rotatable valve member with two passages therein determines fluid flow between the body passages and thereby controls the actuator. If a plurality of such conventional valves are required to control a plurality of actuators, each valve must be connected to the actuator it controls and, either directly or by complicated interconnecting tubing, to the fluid supply source and fluid reservoir. This requires much space, complicated arrangements and duplication of tubing and other components.

In accordance with the present invention these and other drawbacks are overcome by providing an improved system comprising a plurality of improved rotary valves designed to be stacked together in a compact arrangement. Each valve comprises a body having a cavity in which a rotary cylindrical valve member is located. The valve member has two annular grooves therein, one of which is a fluid supply chamber and the other of which is a fluid return chamber. Each chamber is alternatively connectable through passages in the valve member to either of two actuator ports in the valve body. These actuator ports are connected to the actuator being controlled by the valve. The supply chamber and return chamber are also in communication with one or more supply ports and return ports, respectively. When a plurality of valves are stacked and secured together, the supply ports and return ports of one valve body communicate with those of an adjacent valve body necessary to connect the supply port and return port of only one valve body to the fluid source and fluid reservoir, respectively, to effect fluid supply and return for all valves in the stack, regardless of their number.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide improved rotary valves which can be stacked together in improved compact, uncomplicated and versatile systems or arrangements whenever a plurality of valves are required.

Other objects and advantages of the invention will hereinafter appear.

DESCRIPTION OF THE DRAWING

The accompanying drawing illustrates a preferred embodiment of the invention but it is to be understood that the embodiment illustrated is susceptible of modifications with respect to details thereof without departing from the scope of the appended claims.

FIG. 1 shows a system employing a plurality of rotary valves in accordance with the present invention;

FIG. 2 is a top plan view with portions broken away of valves shown in FIG. 1;

FIG. 3 is a cross sectional view of one valve taken along line III—III of FIG. 2; and

FIG. 4 is an enlarged view of a portion of the valve shown in FIG. 3.

DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the numeral **10** designates a stack comprising a plurality of rotary valves in accordance with the invention. Nine valves, individually designated **12***a* through **12***i* are arranged in a stack three valves high and three valves wide. Valve **12***a* is connected to an actuator **14** which it controls, as hereinafter explained, by tubes **16** and **18**. It is to be understood that each valve **12***b* through **12***i* is similarly connected to an actuator such as actuator **14**.

Actuator **14**, for example, comprises a cylinder **28** having a piston **30** which is understood to be axially movable in opposite directions in response to the flow of fluid into the cylinder from either tube **16** or **18**, as the case may be.

Valve **12***i* is connected to a source or supply **32** of fluid under pressure and to a fluid return reservoir **34** by tubes **36** and **38**, respectively. If preferred, source **32** and reservoir **34** may be interconnected as by means **39**.

FIGS. 2 and 3 show, among other things, the details of construction of valve **12***h* which, except as hereinafter explained, is identical to the other valves in stack **10**. Valve **12***h*, for example, comprises a body **40** having a cylindrical cavity **42** therein. A pair of first and second actuator ports **44** and **46** on the rear side of body **40** communicate with the cavity through the rear wall **48** of the body and are adapted for connection to the actuator controlled by valve **12***h*. A rotary valve member **50** in the form of a cylinder is disposed in cavity **42** of body **40** and is provided with a valve stem **52** which extends through a hole **54** in a cover plate **56** on the front side side of the body. Member **50** is provided with two annular grooves **58** and **60** in the circumference thereof which cooperate with body **40** to serve as a fluid supply chamber and a fluid return chamber, respectively. Member **50** is further provided with two passages **62** and **64** which extend between the chambers **58** and **60**, respectively, and the end face of member **50**. It is to be understood that in one position of valve member **50** the passages **62** and **64** communicate with the actuator ports **44** and **46**, respectively. However, when valve member **50** is rotated 180° to its other position, the passages **62** and **64** are reversed and communicate with the actuator ports **46** and **44**, respectively.

As FIG. 4 best shows, a clearance space **66** exists between the end surface **68** of valve member **50** and the end wall **70** of cavity **42** to accommodate fluid-tight washers or seals **72** and **74** which are provided in the enlarged openings at the end of the passages **62** and **64**, respectively, of valve member **50**. The washers **72** and **74** are adapted to slide on the smooth end wall **70** of cavity **42**. Resilient O-rings **76** and **78** are provided behind the seals **72** and **74**, respectively, to help bias the seals and provide a fluid-tight arrangement. Body **40** of valve **12***h* is provided on its side **80** with a supply port **82** and a return port **84** which communicate with fluid supply chamber **58** and fluid return chamber **60**, respectively, and is also provided on its opposite side **86** with first and second connecting ports **88** and **90** which communicate with the chambers **58** and **60**, respectively.

As FIG. 2 shows, valve **12***h* is disposed between valves **12***g* and **12***i* which are similar in construction to valve **12***h*, except as hereinafter explained. The body of valve **12***g* is provided with supply and return ports **92** and **94**, respectively, which register and communicate with the ports **88** and **90**, respectively, in valve **12***h* when valves **12***g* and **12***h* are stacked together as shown in FIGS. 1, 2 and 3. Similarly, the body of valve **12***i* is provided with first and second connecting parts **96** and **98** which register and communicate with ports **82** and **84**, respectively, in valve **12***h* when valves **12***h* and **12***i* are stacked together. The body of valve **12***i* is further provided with supply and return ports **104** and **106** which communicate with source **32** and reservoir **34**, respectively, shown in FIG. 1.

It is to be understood that each valve in stack **10** shown in FIG. 1 is provided with such ports as are necessary to connect it to one or more adjacent valves. Thus, only one valve in a stack needs to be connected directly to the source and to the reservoir. Each other valve is indirectly connected thereto through at least one of its adjacent valves. As FIGS. 1 and 2 show, the valves in stack **10** are secured together by suitable bolts **108** which engage flanges **110** or are disposed in notches **112** provided on or in the bodies of the valves. Preferably, resilient washers **114** are provided between the adjacent valve bodies around the communicating ports.

In a preferred embodiment of the invention the sides of each valve body are flat so that the valves can be stacked compactly in a minimum amount of space. During manufacture of the valves, the supply and return ports and the connecting ports, all of which are to be located in the sides, tops or bottoms of the valve bodies, are provided simply by drilling holes after the stacking arrangement is decided upon for a particular installation.

The system shown in FIG. 1 operates as follows. Fluid from source **32** is supplied under pressure through tube **36** and port **104** to the fluid supply chamber of valve **12***i* and from these through port **96** and port **82** in a valve **12***h* to fluid supply chamber **58** in valve **12***h*. Fluid is supplied to the supply chamber in all valves in stack **10** through associated supply ports in a similar manner.

With all supply chambers charged with pressurized fluid, each valve can be operated independently (or in any combination) to effect operation of its associated actuator.

For example, assume that valve **12***h* is charged and that its valve member **50** is in a position where its passages **62** and **64** are out of registry with the ports **44** and **46**. In this positon, no fluid flows to the actuator.

Now assume that valve member **50** is rotated to a first position, such as shown in FIG. 3, wherein passages **62** and **64** register with ports **44** and **46**, respectively. In this condition fluid flows from supply chamber **58**, through passage **62** and port **44** to one side of its associated actuator causing a desired operation of the latter and displacement of fluid at the other side of the actuator. The displaced fluid is returned through port **46**, through passage **64** to return chamber **60** of valve **12***h* and from

there through port **84** and the ports **98** and **106** and the return chamber of valve **12***i* to reservoir **34**.

To effect reverse operation of the actuator associated with valve **12***h*, member **50** is rotated 180 degrees to a second position wherein its passages **62** and **64** are in registry with ports **46** and **44**, respectively. In this condition fluid flow to and from the actuator is reversed and reverse operation of the latter is effected.

As FIG. 3 shows, valve **12***e* which is located above valve **12***h* is connected thereto by ports **111** and **113** in the bottom wall of valve **12***e* which registers with ports **115** and **116**, respectively, in the top wall of valve **12***h*.

Valve **12***h* may be used in other arrangements than the one shown and, may, therefore, be provided with ports **118** and **120** in its botom side which can be closed or plugged when not in use, as by plugs **122** and **124**, respectively.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a hydraulic system,
a fluid source,
a fluid return reservoir,
a plurality of actuators,
and a plurality of stackable valves for controlling fluid flow between said source and said actuators and between said actuators and said return reservoir,
each valve comprising a valve body and a rotatable cylindrical valve member disposed therein,
said valve body and said valve member cooperating to provide a fluid supply chamber and a fluid return chamber,
said valve member being provided with a supply passage therein and with a return passage therein,
said valve body being provided with a first actuator port for communicating between said actuator and said supply chamber through said supply passage when said valve member is in a predetermined position,
said valve body being further provided with a second actuator port for communicating between said actuator and said return chamber through said return passage when said valve member is in said predetermined position,
and said valve body comprising a supply port for communicating with said supply chamber and a return port for communicating with said return chamber,
at least one of said plurality of valves having its supply port connected with said source and its return port connected with said reservoir,
said one valve having a valve body which is provided with first and second connecting ports which communicate with the supply chamber and the return chamber thereof, respectively,
and said first and second connecting ports of said one valve being in communication in all positions of said one valve with the supply port and the return port, respectively, of one other valve in the system.

2. A system according to claim **1** wherein said valve member is provided with two annular grooves, one of which serves as said fluid supply chamber and the other of which serves as said fluid return chamber.

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