United States Patent

[11] 3,538,949

[72] Inventors **Manfred Kramer**
Fellbach-Lindle and
Heinz Kleinschmidt, Stuttgart, Germany

[21] Appl. No. **815,433**
[22] Filed **April 11, 1969**
[45] Patented **Nov. 10, 1970**

[73] Assignee **Robert Bosch G.m.b.H.**
Stuttgart, Germany

[32] Priority **Oct. 25, 1968**
[33] **Germany**
[31] **1,805,089**

---

[54] **FLUID FLOW CONTROL APPARATUS**
10 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** **137/596,** 137/567, 137/625.48, 137/625.4, 137/625.69, 91/6, 137/608

[51] **Int. Cl.** **F16k 11/10,** F16k 11/07

[50] **Field of Search** 137/596, 567, 625.4, 625.48, 625.69, 608; 91/6

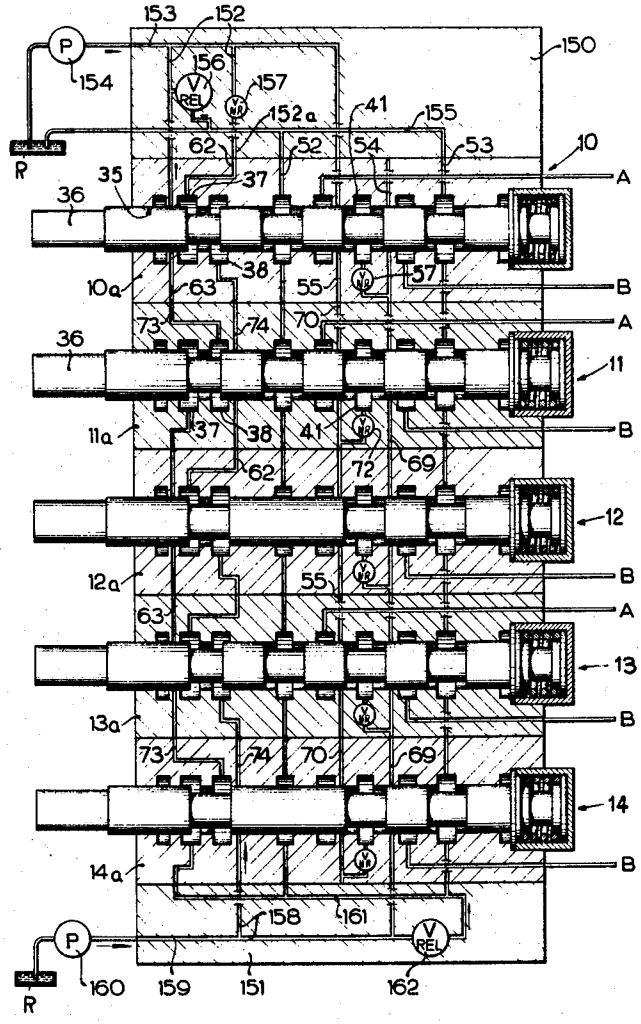
[56] **References Cited**

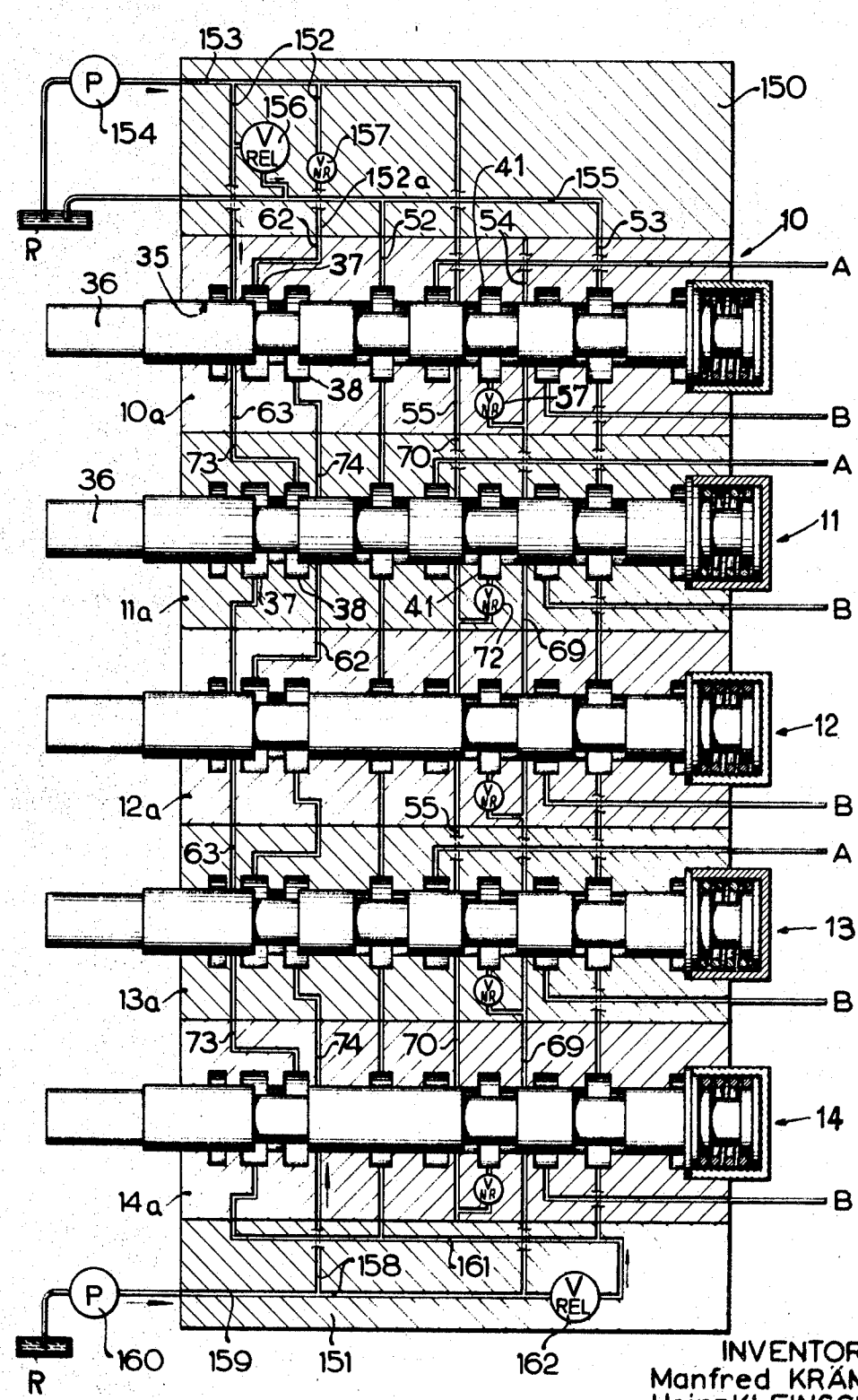
UNITED STATES PATENTS

2,800,798	7/1957	Korsmo	137/625.4X
3,204,662	9/1965	Williams	137/596

Primary Examiner—Henry T. Klinksiek
Attorney—Michael S. Striker

ABSTRACT: A fluid flow control apparatus wherein two groups of sliding spool directional control valves can be arranged in random distribution and serve to regulate the flow of hydraulic fluid to discrete loads. The bodies of the valves are disposed side-by-side between two channelled blocks each of which is connected to a pump and each of which is formed with a pressure line serving to convey fluid from the respective pump to channels in the bodies of the valves. Such channels form two fluid circulating passages both of which are connected to one of the pressure lines and one of which is connected to the other pressure line, and two connecting passages each of which is connected to a different pressure line. The other fluid circulating passage is connected to a collecting line which communicates with a reservoir by way of return channels provided in the valve bodies.





INVENTORS
Manfred KRÄMER
Heinz KLEINSCHMIDT
By
Michael S. Striker
their ATTORNEY

FLUID FLOW CONTROL APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to improvements in fluid flow control apparatus, and more particularly to improvements in apparatus for regulating the flow of pressurized hydraulic fluid to two or more single-acting or double-acting loads. Still more particularly, the invention relates to improvements in fluid flow control apparatus of the type disclosed in the copending U.S. Pat. application Ser. No. 804,473 of Kraemer, filed March 5, 1969 and assigned to the same assignee.

SUMMARY OF THE INVENTION

An object of our invention is to provide a fluid flow control apparatus with a battery of directional control valves which receive pressurized hydraulic fluid from two sources, each of which can regulate the flow of fluid to and from a discrete load, and wherein the valves can be arranged in random distribution.

Another object of the invention is to provide an apparatus wherein a group of valves can receive fluid from both sources or only a portion of fluid which is circulated by such sources.

A further object of the invention is to provide an apparatus which can operate properly without a flow regulating valve.

The improved apparatus serves to control the flow of pressurized hydraulic fluid to plural loads and comprises a first and a second group of directional control valves, each valve being connected with one of the loads and each group of valves comprising at least one valve having a body and a valve member installed in the body for movement between a neutral position and at least one working position in which the corresponding load is respectively sealed from and connected with at least one source of pressurized fluid, first and second fluid circulating passages and first and second connecting passages provided in the bodies, the first passages being controlled by valve members in the first group and the second passages being controlled by valve members in the second group, means defining a first pressure line connected with both fluid circulating passages and with one of the connecting passages, means defining a second pressure line connecting the other connecting passage with one of the fluid circulating passages, and means defining a collecting line communicating with the other fluid circulating passage and with return channel means provided in the bodies and communicating with a reservoir.

Each pressure line is connected with a discrete pump or other suitable source of pressurized fluid.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved fluid flow control apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single FIG. is a schematic sectional view of a fluid flow control apparatus which embodies the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawing shows a fluid flow control apparatus which comprises a battery of five sliding spool directional control valves **10—14** whose bodies **10*a*—14*a*** are arranged side-by-side and are flanked by two channelled blocks including a connector block **150** and an end block **151**. The construction of valve bodies **10*a*—14*a*** and of their valve members or spools **36** is the same as described in the aforementioned copending application of Kraemer to which reference may be had if necessary. The connector block **150** is formed with a main pressure line or channel **153** which is connected with the discharge end of a first source of pressurized fluid here shown as a pump **154** drawing hydraulic fluid from a reservoir R. The main pressure line **153** is connected with or forms part of a pressure line **152** which communicates with a first fluid circulating passage including sections **63** provided in bodies **10*a***, **12*a***, **13*a*** of a first group including the valves **10**, **12**, **13** and sections **73** provided in the bodies **11*a***, **14*a*** of a second group including the valves **11**, **14**. The sections **63** bypass the bores **35** for the spools **36** in the bodies **10*a***, **12**, **13*a*** but the sections **73** communicate with interconnected chambers or enlarged portions **37**, **38** in the bores **35** of bodies **11*a***, **14*a***. Thus, the spools **36** in the bodies **10*a***, **12*a***, **13*a*** cannot influence the flow of fluid in the sections **63** but the spools **36** in the bodies **11*a***, **14*a*** can permit or prevent the flow of fluid through the sections **73**. The pressure line **152** of the connector block **150** further communicates with a first connecting passage including sections or channels **55** in the bodies **10*a***, **12*a***, **13*a*** and sections or channels **70** in the bodies **11*a***, **14*a***. The sections **55** bypass the spools **36** in the bodies **10*a***, **12*a***, **13*a*** but the flow of fluid through the sections **70** can be influenced by the spools **36** in the bodies **11*a***, **14*a*** if such spools are moved between neutral and working positions. The sections **70** are connected with supply chambers **41** of the bodies **11*a***, **14*a*** by one-way valves **72**. The supply chambers **41** can admit pressurized hydraulic fluid to the part A or B of a double-acting load connected to each of the valves **10—14**.

A branch **152*a*** of the pressure line **152** in the connector block **150** contains a one-way valve **157** and is connected with a second fluid circulating passage including sections **62** in the bodies **10*a***, **12*a***, **13*a*** and sections **74** in the bodies **11*a***, **14*a***. The sections **74** bypass the spools **36** in the bodies **11*a***, **14*a*** but the spools **36** in the bodies **10*a***, **12*a***, **13*a*** can interrupt the flow of fluid through the corresponding sections **62**. Each section **62** includes two enlarged portions or chambers **37**, **38** in the corresponding body **10*a***, **12*a*** or **13*a***.

A return line or channel **155** in the connector block **150** discharges fluid into the reservoir R and is connected with return channels **52**, **53** provided in the bodies **10*a*—14*a***. A pressure relief valve **156** is connected between the return line **155** and pressure line **152**. The aforementioned one-way valve **157** prevents flow of fluid from the pressure line **152** into the fluid circulating passage including the sections **62**, **74**.

The end block **151** includes a pressure line or channel **158** which is connected by a main pressure line or channel **159** with the discharge end of a second source of pressurized fluid here shown as a pump **160**. The pressure line **158** has a branch which communicates with a second connecting passage including sections **54** provided in bodies **10*a***, **12*a***, **13*a*** and sections **69** provided in the bodies **11*a***, **14*a***. The pressure line **158** further communicates with a second fluid circulating passage including sections **62** and **74**. The flow of fluid in sections **54** can be influenced by the spools **36** of bodies **10*a***, **12*a***, **13*a*** but the sections **69** bypass the spools in the bodies **11*a***, **14*a***. A collecting channel or line **161** is connected with the pressure line **158** by way of a pressure relief valve **162**. The line **161** is further connected with the return channels **52**, **53** and with the fluid circulating passage including the sections **63**, **73**.

The operation:

The drawing shows all spools **36** in their neutral positions. The pump **160** delivers a stream of pressurized fluid which flows through the pressure line **159** into the pressure line **158** and through the fluid circulating passage including the sections **62**, **74** into the line **152** of the connector plate **150**. This fluid stream merges into the other fluid stream which is delivered by the pump **154** and flows by way of the lines **153**, **152**. The thus merged fluid streams flow through the fluid circulating passage including the sections **63**, **73**, through the collecting line **161** of the end block **151** and return channels **52**, **53** of the valve bodies **10*a*—14*a*** to the return line **155** and thence into the reservoir R.

If the spool **36** of one (for example, **10**) of the first group of valves **10**, **12**, **13** is moved to one of its working positions, such spool seals the corresponding section **62** from the adjoining

section 74. Consequently, the stream furnished by the pump 160 cannot reach the branch line 152; it must flow through the connecting passage including the sections 69 and 54. In the body 10*a*, the spool 36 (in its working position) permits fluid to flow from the corresponding section 54 into the supply chamber 41 (byway of a one-way valve 57) and thence into the part A or B of the corresponding load. The stream delivered by pump 154 flows through the connector block 150 into the fluid circulating passage including the sections 63, 73, through the end block 151 and the return channels 52, 53 back to the return line 155 and reservoir R.

If one of the spools 36 in the body 11*a* or 14*a* (for example, in the body 11*a*) of the second group of valves is moved to one of its working positions, such spool 36 then prevents the flow of fluid from the pump 154 through the corresponding section 73 of the fluid circulating passage including the sections 63, 73. The fluid stream delivered by pump 160 flows through the end block 151, through the fluid circulating passage including the sections 62, 74 and into the pressure line 152 where it merges with the stream delivered by pump 154. The thus merged streams flow through the passage including the sections 55, 70 whereby the spool 36 in the body 11*a* permits the corresponding section 70 to deliver pressurized fluid to the supply chamber 41 of the body 11*a* by way of the one-way valve 72. The supply chamber 41 of the body 11*a* then delivers fluid to the part A or B of the corresponding load, depending on the selected working position of the spool 36 in the valve 11.

If a spool 36 of the first group of valves (for example, of the valve 10) is moved to one of its working positions simultaneously with a spool 36 of the second group of valves (for example, valve 11), such spools seal the corresponding sections 62, 73 of the two fluid circulating passages. The pump 160 then delivers fluid to the valve 10 by way of the connecting passage including sections 69, 54 and the pump 154 delivers fluid to the valve 11 by way of the connecting passage including sections 55, 70. The adjustment of the spool 36 in the valve 10 can be such that it delivers fluid to the corresponding load A, B at a low pressure and the valve 11 can be set to deliver fluid at a high pressure to the part A or B of the corresponding load. The one-way valve 157 then serves to prevent flow of fluid from the pump 154 into the fluid circulating passage which includes the sections 62, 74.

If desired, the illustrated apparatus can be modified by connecting the pumps 154 and 160 with the connector block 150. The pressure line 159 is then provided in the block 150 and connects the pump 160 with the connecting passage including the sections 54, 69. Inversely, the pump 154 can be connected with the connecting passage including the sections 70, 55 by way of the end block 151. The line 153 is then provided in the block 151. The valves 10—14 can be distributed in a number of different ways, for example, by interchanging the positions of valves 11, 12 or 11, 13.

An important advantage of our apparatus is that it can dispense with the regulating valve which is shown in FIG. 7 of the aforementioned Kraemer application. Such regulating valve is employed in the apparatus of Kraemer to divide a fluid stream which is delivered by a single pump into a main stream and a residual stream. One group of valves receives the main stream and the other group of valves receives the residual stream or the total stream when the valves of the first group are held in neutral positions. It was found that, under certain circumstances, the output of an apparatus using the aforementioned regulating valve is rather low and that such apparatus does not exhaust all possibilities of taking full advantage of both fluid streams.

A feature of our apparatus resides in that the pressure line 152 of the connector block 150 is connected with both fluid circulating passages (sections 62, 74 and 63, 73) and with one of the connecting passages (sections 55, 70), and that the pressure line 158 connects the other connecting passage (sections 54, 69) with the depending one of the fluid circulating passages (sections 62, 74). Such arrangement of channels, lines and passages renders it possible to supply one group of directional control valves with the total amount of circulated fluid or with a residual amount without resorting to a flow regulating valve.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art.

We claim:

1. In an apparatus for controlling the flow of pressurized hydraulic fluid to a plurality of loads, a combination comprising a first and a second group of directional control valves, each of said valves being connected with one of the loads and each group comprising at least one valve having a body and a valve member installed in the body for movement between a neutral position and at least one working position in which the corresponding load is respectively sealed from and receives pressurized fluid, said bodies defining first and second fluid circulating passages and first and second connecting passages, said first passages being controlled by a valve member of said first group and said second passages being controlled by a valve member of said second group; means defining a first pressure line connected with said fluid circulating passages and with one of said connecting passages, means defining a second pressure line connecting the other connecting passage with the depending one of said fluid circulating passages; and means defining a collecting line communicating with the other fluid circulating passage and with return channel means provided in said bodies.

2. A combination as defined in claim 1, further comprising first and second sources of pressurized fluid respectively connected with said first and second pressure lines.

3. A combination as defined in claim 1, further comprising a first source of pressurized fluid connected with said first pressure line and with said one connecting passage and a second source of pressurized fluid connected with said second pressure line and said other connecting passage.

4. A combination as defined in claim 1, wherein the means defining said first and second pressure lines comprises two channeled blocks flanking said bodies.

5. A combination as defined in claim 4, wherein the means defining said collecting line forms part of one of said blocks.

6. A combination as defined in claim 1, wherein said bodies have abutting side faces.

7. A combination as defined in claim 1, wherein the valves of said first and second groups are in random distribution.

8. A combination as defined in claim 1, further comprising relief valve means connected with each of said pressure lines.

9. A combination as defined in claim 1, further comprising one-way valve means interposed between said first pressure line and said one fluid circulating passage.

10. A combination as defined in claim 1, wherein said directional control valves are sliding spool valves.