A valve for distributing fluid to a system of fluid-actuated machines in which a monobloc defines a plurality of spaced compartments, with each compartment having ports communicable with an individual machine of the system, first passage means in the monobloc for distributing fluid equally to the compartments, each compartment having a cavity to establish a second passage means for supplying fluid to the compartments and communicable with fluid outflow means from said monobloc, a pair of channels communicable with each of said compartments to exhaust fluid therefrom, first valve means in each compartment to direct the flow in said second passage means, and second valve means interposed between said first passage means and said compartment to control the flow of fluid to each machine whereby the machines may be actuated in series-parallel, in series or in parallel.

4 Claims, 8 Drawing Figures
VALVE FOR DISTRIBUTING FLUID TO A SYSTEM OF FLUID-ACTUATED MACHINES

BACKGROUND OF THE INVENTION

The present invention relates to an improvement of multielement directional valves for oleodynamic controls, also known as hydrodynamic flow distributors, arranged for the actuation of hydraulic machines.

It is known that, in its simplest form, an oleodynamic circuit is formed by a tank containing the hydraulic fluid, a pump drawing-in fluid and conveying it under pressure to the different "consumption" devices consisting of one or more hydraulic machines: rams, motors having pistons, or gears or any other device which converts the potential energy of the fluid into mechanical energy.

It is also known that it is necessary to interpose, between the sources of energy, (the pump) and the devices applying the same, connective and disconnective switching elements serving to provide the system with the means of satisfying the various operating requirements prevailing for these application devices. These elements consist of directional or distributor valves. The distributing function is determined by the nature of the connections and the same renders it possible to establish communication between the pump and the application devices, between the pump and the tank, between the application devices per se and between these application devices and the tank.

As a rule, the operation of distributing a flow of oil in a variety of ways presupposes the presence of a stationary unit equipped a fluid inflow connector, with an outflow connector connected to the tank and connectors connected to the application devices.

This stationary unit moreover, has appropriate internal cavities within which are displaced by external actuation, one or more displacable elements, with pistons or cylindrical cursors provided with grooves or bores, with the cursors being arranged to uncover particular passages and to cover others, during their displacement.

The distributor comprises different elements or sections, of which each has its cursor and there are as many elements as there are hydraulic machines to operate with each section being equipped with one or two connectors for the pipes leading to the application devices.

If the section has a single connector (single-action), the fluid leaves and returns to the distributor to and from the hydraulic machine, traversing one and the same pipe in both directions. During outward flow is performed the transmission of power by means of the fluid which accumulate within the ram chamber whereas the return flow is operated by the action of the spring or weight applied to the ram draining the latter of fluid which is caused to traverse the path in the reverse direction.

If the section has two connectors (double-action), the fluid is conveyed from one connector of the distributor to the application device, while the return flow of the fluid from the application device to the second connector of the element of the distributor occurs at the same time.

By controlling the cursor of the distributor, it is possible to ensure a reversal of the displacement of the fluid.

The single-action may, however, be employed only for actuation of double-action rams, and oleodynamic motors.

Disregarding the control system of the cursors of each element (which may be manual, or electromagnetic, or pneumatic or hydraulic), it is evident that actuating the cursors beyond determining a particular kind of connection between the pumps and the application device corresponding to a particular section, a relationship prevails which links all the elements of a particular distributor.

This is evident, considering that there is a single source of fluid supply and a single inflow connector for the distributor.

Considering the distributor formed by two or more elements (ignoring that having a single element which is not of interest to the present invention), it is known that the connections of the different sections are governed by three conditions, namely (a) single in feed.

By operating the cursor of any section, the source of fluid supply (pump) is connected to the corresponding application machine, precluding the supply to all the other following sections, which are not supplied although they are operated (b) supply in parallel.

By operating a cursor of any section, the fluid is connected to the appropriate application device, without preventing all the other sections per se from being supplied by the pump as well.

All the sections are thus constantly and simultaneously connected to the source of supply (c) supply in series.

By operating a cursor of one section, the source of supply is connected to the appropriate application device, precluding the supply to all the other following sections as in condition (a), with the difference that the discharge from the application device operated feeds the following sections if operated at the same time.

The known distributors are commonly formed by combination of different elements assembled together, of which each one represents a control section.

Until now, a system of this kind rendered it possible to obtain, by appropriate combination and with adjunction of separators or neutral sections, an integral multisecti onal distributor offering the possibility of having these sections set for feed by single supply, supply in parallel or in series, according to requirements.

It is also known that to produce different kinds of supply, the incorporation of several distributors was resorted to, for example, a three-element distributor employing feed in parallel, together with a single-element distributor employing feed in series.

This last system simply became essential with the advent of the production of "monobloc" distributors. Instead of being formed by different sections, the monobloc distributor consists of a single unit cast in one piece, which nevertheless represents the required sections as well, being equipped internally with all the intercommunication cavities, and externally with all the connectors for the application devices, thus being equivalent to an already assembled composite distributor.

Although the monobloc distributor offers a great advantage from the structural point of view as well the elimination of oil losses between the sections, it imposed the necessity of employing several distributors whenever it is desired, for example, to have a set of sections fed in parallel and another set fed in series, and this is due to the impossibility of insertion between the sections of the separating elements which are employed in sectional distributors.

On strictly theoretical premises, it is possible without any difficulty, to produce a monobloc distributor having one section supplied in different manner from another, but it is plain that experimental needs could be fulfilled for each combination by a special casting and a special machining operation for each case, without offering the possibility an economically viable industrial production.

SUMMARY OF THE INVENTION

The present invention suggests a monobloc multisecti onal distributor in which the internal structure of each section remains identical and machined in identical manner, with the possibility, however, of obtaining any kind of supply simply by changing the cursor and a nonreturn valve whose locations in the unit remain unchanged.

Moreover, the kind of supply (whether single-feed, feed in parallel, in series) may be established at will in any section of the monobloc unit, intercalating the different feeds as required.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by way of example with reference to the accompanying drawings.
FIG. 1 is a top plan view of a four-section monobloc distributor,
FIG. 2 is a view looking in the direction of arrow in FIG. 1,
FIG. 3 is a view in cross section taken along the line BB' of
FIG. 1, the view looking in the direction of the arrows,
FIG. 4 is a view in section taken along the line DD' of FIG. 2, the
view looking in the direction of the arrows,
FIG. 5 is a view in section taken along the line CC' of FIG.
4, the view looking in the direction of the arrows,
FIG. 6 is a sectional view of the nonreturn valve for supply in
parallel,
FIG. 7 is a sectional view of the nonreturn valve for supply in
series or for single feed, and
FIG. 8 is a sectional view of cursor appropriate.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, only those elements and details
which relate to methods of supplying (parallel, series, single-
feed) the fluid to the different elements making up the dis-
tributor, will be considered. All the ancillaries (valves, control
levers, switches etc.) common to all the distributors but which
are not of interest for the present invention have been
omitted.

In FIG. 1 it is apparent that a fluid inflow connector 6 and a
outflow connector 7 are provided. Compartments 8–9–10–11
are the elements which, although they have in common a
monobloc unit 12, constitute the four controls which are each
intended to lead the corresponding oleodynamic machine.

The element 8 has connectors 13 and 14 for the delivery
and return of the fluid from the distributor to the receiving
machine. Similarly, the elements 9 have two connectors
15–16, the element 10 connectors 17–18, and the element 11
connectors 19, 20. Each element 8–9–10–11 carries cor-
responding cursors or slide-valves 21–22–23–24 (FIGS. 1, 2).
The cursors 21–22–23–24 do not appear in the corresponding
seats in FIG. 4.

In FIG. 4, are shown three of the four connections joining the
elements 8–9–10–11. Two connections are defined by two
discharge passages 25 and 26 which extend along the outer
longitudinal sides and lead to a discharge or outflow chamber
27 in communication with the outflow connector 7.

A third connection is obtained by means of a central forked
passages 28–29–30 which starts an inlet or inflow chamber 29,
and after having traversed all the elements 8–9–10–11 also
opens into the discharge chamber 27. A fourth connecting
passage 30 (FIG. 5) also starts from the inlet chamber 29, but
after having traversed all the elements 8–9–10–11 terminates
in a dead end after the last element 11. In FIG. 3 are illustrated
the four passages 25–26–28–30 in section. In FIG. 3 illustrat-
ing the sectioned elements 8 are apparent the tow connectors
13 and 14 for the "receivers" which are connected through
corresponding passages 31 and 32 to annular openings 33 and
34 of a bore 35 housing the cursor 21. Two other openings or
parts 36 and 27 (FIG. 3) provided in the bore 35, are intercon-
ected by a bridging passage 38. The central connecting
passage 28 (FIGS. 3–4) which in alignment with each cursor-
housing bore branches into two forked portions 39 and 40
(FIG. 4), forming the corresponding passages 28–39–40
within the cursor-housing bore 35; the two forked portions
39–40 (FIG. 3) are, at the top, connected by a bridging
passage 41. The connecting passage 30, the bridging passage
38 and the bridging passage 41 are in communication with
each other through a bore 42 having different diameters
(FIGS. 3 and 5) with the bore 42 being adapted house valves
of the two types illustrated in FIGS. 6 and 7. In FIG. 6 is illus-
trated a valve formed by four components 43–44–45–46,
which provides an access for supply of the fluid from the
passage 30 to the passage 38 and prevents its return. The fluid
from the passage 30 traversing holes 47 of the component 44
opens the valve head 43 by overcoming the action of spring
46 and thus reaches the bridging passage 38. The socket 45
serves for housing the spring 46 but above all constantly keeps
closed the passage between the bridging passage 41 and the
bridging passage 38.

In FIG. 7 is illustrated a valve formed by three components
48–49–50 which provides an access for supply of the fluid
from the passage 41 to the passage 38 and prevents its return.
The fluid from the passage 41 lifts the valve head 48, over-
coming the action of spring 50, thereby passing directly to the
passage 38. Apart from housing the spring 50, thereby the
component 49 primarily serves to constantly keep closed the
passage between the passage 30 and passage 38. It is im-
portant to note that although the component 49 bars communica-
tion between the passages 30 and 38, it does not completely
obstruct the passage 30 (FIG. 3), allowing the fluid to flow
equally traversing all the elements 8–9–10–11.

The two valves (FIGS. 6 and 7) may be installed at will in
the bore 42 of each element.

In FIG. 3 is shown a normal cursor 21 for a control of the
double-action type. In FIG. 8 is disclosed a cursor 62 also ap-
propriate for control of a double-acting device but provided
with an internal passage to carry the discharge coming from
the receiving machine, for supply in series of the following ele-
ment.

SUPPLY IN PARALLEL OF THE ELEMENTS

In the bores 42 of each element is installed the nonreturn
valve illustrated in FIG. 6. The fluid fed into the distributor
through the inflow connector 6 (FIGS. 1–4–5) reaches the
inlet chamber 29, and from the latter chamber traverses the
passages 30 and 28/39/40 of each compartment.

From the passage 30, the fluid may reach the bridging chann-
els or passages 38 of each compartment through the non-
return valve head 43 (FIG. 6). Considering that all the
openings or ports 36 and 37 are covered by the cursors in the
idle position and that the passage 30 is a dead end, it is evident
that the fluid fed to the passage 30 is held up when the cursors
are in the idle position (FIG. 3).

The fluid traversing the passage 28 may pass from the
forked portions 39–40 to the central passage 28 (FIG. 4) in-
asmuch as the cursors in the idle position leave the ports
39–40 uncovered (FIG. 3). Accordingly, the fluid may
trace all the elements 8–9–10–11 and reach the chamber
27 and may issue from the latter chamber towards the tank
through the outflow connector 7.

By displacing any of the cursors (for example towards the
left in FIG. 3), the central passage 28 is closed and communi-
cation between the port 37 and the annular opening 34 is
established at the same time; accordingly, the fluid will
traverse the supply path to the return connector 14 (FIG. 3)
from the inflow connector 6 to the inlet chamber 29, to the
passage 30 (FIG. 5) through the valve head 43 (FIG. 6) to the
bridging passage 38, the port 37, the annular opening 34, the
passage 32 and to the return connector 14.

The same displacement establishes communication between
the annular opening 33 and the passage 26, placing the
delivery connector 13 in communication with the outflow.

In point of fact, the returning fluid traversing the passage
31, the annular opening 33, the discharge passage 26 and the
same passage 26 (FIG. 4), reaches the chamber 27 and thus
the outflow connector 7.

By displacing the cursor towards the right simply causes
reversal of the feed, operating outwards from the delivery con-

ector 13, through the components 30–38–36–33–31–13, and
returning to the discharge of the return connector 14 through
the passage 32, annular opening 34 and discharge passage 25.

The supply of one element (8) having been described, it will
be appreciated that by virtue of the connecting passage 30 (FIG.
5) which traverses all the elements 8–9–10–11, it is possible
to supply all the elements in parallel at the same time
by simultaneously actuating the cursors. The fluid entering
the distributor will obviously be divided in quantity between
the different feed lines.
SINGLE FEED.

In the bore 42 of each element is installed the nonreturn valve illustrated in Fig. 7. The fluid fed into the distributor by the inflow connector 6 (Figs. 1-4-5) reaches the chamber 29 and from the latter chamber the passages 30 and 28. The entire length of the passage 30 is traversed by the fluid inasmuch as the component does not wholly obstruct the passage 30 (Fig. 7) but the same passage 30 will not perform any feed since all the passages from the passage 30 to the passages 38 are stopped by the components 49.

Instead, the fluid traversing the passage 28 passes, with the cursor in the idle position, through all the elements entering and traversing all the forked portions 39-40 until it enters the chamber 27 from which it flows to outflow connector 7.

This corresponds precisely to the case of supply in parallel previously described.

The closure of the central passage 28 is equally obtained, for example, by moving the same cursor of Fig. 3 towards the left again as previously.

Considering that the two forked portions 39-40 (which form part of the passage 28) corresponding to each cursor are joined to the bridging passage 41 (Fig. 3), the fluid (un able to traverse the wholly closed passage 30) opens the nonreturn valve head 48 (Fig. 7) overcoming the force of the spring 50, and reaches the bridging passage 38 from which it may equally supply the connectors delivery and return 13 and 14 precisely described in the preceding paragraph with respect to the feed of the element 8 (Fig. 3). In this case, however, the only element to be supplied is in fact the element 8 even if the other cursors of the elements 9-10-11 are operated. This is obvious inasmuch as the connecting passage 30 has all the accesses closed and the central passage 28 is covered by the cursor of the first element 8 actuated for the connectors 13 or 14. Similarly, if the cursor of the element 11 is the first to be actuated, its own connectors 19-20 (Fig. 1) will be supplied as the fluid finds the central passage 28 unobstructed up to the element 11; if, however, another cursor, for example that of the element 9 (Fig. 1) is actuated together with the cursor of the element 11, the fluid will feed only the connectors 15-16 through the passage 28 and the supply to the element 11 will cease immediately as the passage 28 beyond the element 9 is not traversed by the fluid. Consequently, any element of the distributor may be fed singly, but if more than one cursor is actuated at the same time, the supply will occur solely to the actuated element which is closest to the fluid inflow.

SUPPLY IN SERIES.

In the bores 42 of each element is installed the nonreturn valve illustrated in Fig. 7. For supply in series, the distributor is arranged precisely as for the single-feed above described, with the sole difference being the replacement of the cursors. It was found that by actuating any cursor (in the case of single supply), the fluid is allowed to reach the receivers corresponding to this element and only to this element, because the central passage 28 is interrupted downstream of the element actuated. From the preceding description, it is known that in each element (for example of Fig. 3) without the nonreturn valve as illustrated in either Fig. 6 or 7, an actuation of the cursor towards the left causes the outward feed of the fluid issuing from the connector 14 and simultaneously the return of the fluid from the connector 13 for discharge through the passage 26 to the outflow connector 7. Equally, operating the cursor towards the right causes outward feed in the connector 13 and the simultaneous return of the fluid from the connector 14, again towards the outflow connector 7, through the passage 25. Consequently, when actuating any cursor, a return flow is always available, which is discharged through the passages 25 or 26 (Figs. 3-6).

If, instead of the normal cursors similar to the cursor illustrated in Fig. 3, the distributor arranged for single feed has installed thereon the special cursors illustrated in Fig. 8, which, when operated towards the right or left, instead of conveying the returning fluid into the discharge passages 25 and 26, direct this fluid into the central passage 28, downstream of the element actuated, the possibility exists for operating several cursors connected in series at the same time. Thus, the return flow of fluid from one element will represent the supply fluid for the next element. So that this may occur, the special cursor 62 (Fig. 8) internally comprises two axial bores 51-52. Towards the center of the cursor, the bore 52 is in communication with four radial bores 53 and the bore 51 with four other radial bores 54. Towards the extremity of the cursor at one side, the bore 53 leads to four radial bores 55, in a symmetrical manner, the bore 51 leads to four bores 56. Close to the four bores 55 and 56 respectively, the bore 52 and 51 have two nonreturn valves 58 and 59 which ensure that the fluid can flow only in directions denoted by arrows 60-61 and never in the opposite directions.

Displacing the special cursor 62 (Fig. 8), for example, towards the left, the central passage 28 is closed downstream of the same cursor whereas the two other passages open towards the right. When operated, the fluid through the closed passages 39-40 (Fig. 3) makes its way towards the right through the nonreturn valve 48, and the fluid flows through the central passage 28 to the outlet connector 13 (Fig. 7) and the connector 14 (Fig. 8). It is obvious that the fluid when operated towards the right or left, takes the same path of Fig. 3 while being able to function as in the case of single feed. In this case, too, no intermediate return is made possible, since the fluid is discharged through the outlet connector 7 of the distributor unit 13.

COMPOSITE SUPPLY.

It is a very important feature of the present invention that it is possible to establish a supply of a composite nature in the different elements forming a distributor.

For example, in a six-element distributor, it is possible to have one or two elements supplied in single series and two or three elements supplied in parallel. Alternatively, it is possible to interpose an element in series, for example, the third, among five elements arranged parallel to each other.

It is possible, moreover, to supply the first, third, fifth and sixth in parallel with each other, and to supply the second and the fourth in series, relative to the first and third. This is possible because, as has been described, the different kinds of supply are obtained by simply installing the appropriate nonreturn valve and the appropriate cursor in the distributor unit 12 which always remains the same.

By way of example, let us consider the four-element distributor illustrated in Fig. 1, in respect of which we examined the possibility of a supply in parallel, in series and an individual supply to all four elements without changing the unit 12. It is now intended, in the same unit 12, to obtain a supply in parallel to the elements 8-10-11 (Fig. 1), and a supply in series to the element 9 fed in series with the element 8. This composite supply is obtained by installing in the element 8 a cursor 62 (Fig. 8) and in the element 9 a nonreturn valve of the Fig. 7 type. The other cursors installed are of normal type (Fig. 3), and the other valves installed are of the Fig. 6 type. In other examples, in the same unit 12 it is intended to have the element 9 supplied in series with the element 8 and the element 11 supplied in series with the element 10 while at the
same time having the elements 8 and 10 connected in parallel to each other. This is obtained by installing in elements 8 and 10 two cursors of the type shown in FIG. 8 and in elements 9 and 11 two nonreturn valves of the FIG. 7 type; the other valves installed are of the FIG. 6 type and the other cursors of the FIG. 3 type.

I claim:

1. A valve for distributing fluid to a system of fluid-actuated machines comprising a monobloc having fluid inflow and outflow connectors, a plurality of spaced compartments located between the inflow and outflow connectors and extending transversely with respect thereto, each of said compartments having connectors for the delivery and return of fluid to an individual machine of said system, first passage means for distributing fluid equally to said compartments, each compartment having a cavity to establish a second passage means for supplying fluid to said compartments, said second passage means being communicable with said fluid outflow connector, a pair of channels communicable with each of said compartments to exhaust fluid therefrom, first valve means in said compartment and movable therein to direct the flow in said second passage means, and second valve means provided between each compartment connectors and interposable between said first passage means and said compartment to control the flow of fluid to each machine whereby said machines may be actuated in series-parallel, in series or in parallel, said first valve means and second valve means each being of different types whereby proper selection and positioning of the selected valve means in the monobloc determine the type of actuation.

2. The valve as claimed in claim 1, wherein said compartments each comprise a pair of branch conduits, each communicable with a next succeeding compartment to establish said second passage means.

3. The valve as claimed in claim 1, wherein said first valve means is a spool compartment reciprocal in said chamber to direct the flow of fluid to and from each machine.

4. The valve as claimed in claim 1, wherein said second valve means is a nonreturn valve for controlling the flow of fluid to establish the proper system sequence of operation.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3635244 Dated January 18, 1972

Inventor(s) FERRUCCIO LAMBORGHINI

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the Title Page, item 22, change the filing date from "Dec. 12, 1970" to -- Jan. 12, 1970 --.

Signed and sealed this 9th day of May 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR. ROBERT GOTTSCALK
Attesting Officer Commissioner of Patents