

[54] **SELECTOR VALVE FOR RECEIVING &
DISTRIBUTING PLURAL FLOWS**

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[52] U.S. Cl. **137/625.19**

[51] Int. Cl. **F16k 11/02, F16k 11/12**

[58] Field of Search **137/625.19, 625.46**

[56] **References Cited**

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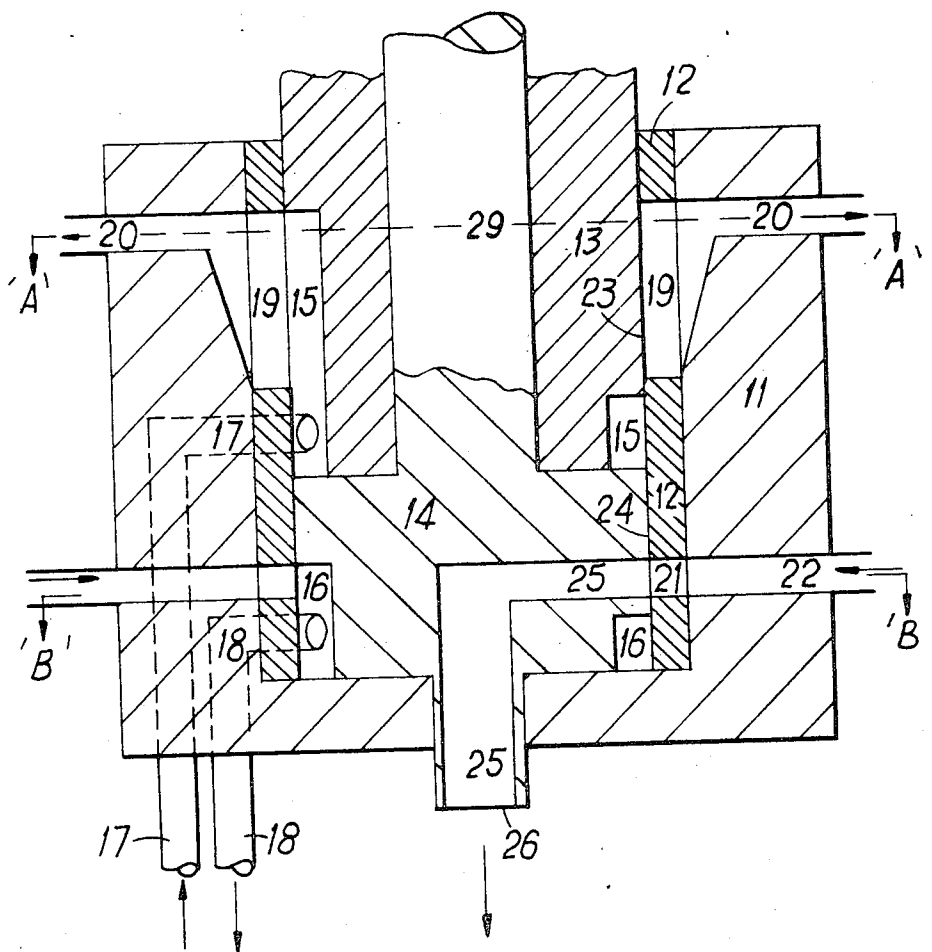
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[57] **ABSTRACT**

A rotary valve for controlling the distribution of fluid flow to and from a number of vessels, such as filters, is adapted in one position to receive a single primary flow from a source, direct a separate fluid stream to each of several vessels, receive back a secondary fluid stream from each vessel and to discharge the combined secondary streams. Other positions of the valve effect blockage of the flow to any one of the vessels to isolate the same, passage to waste of the flow from the isolated vessel and restricted flow to the isolated vessel.

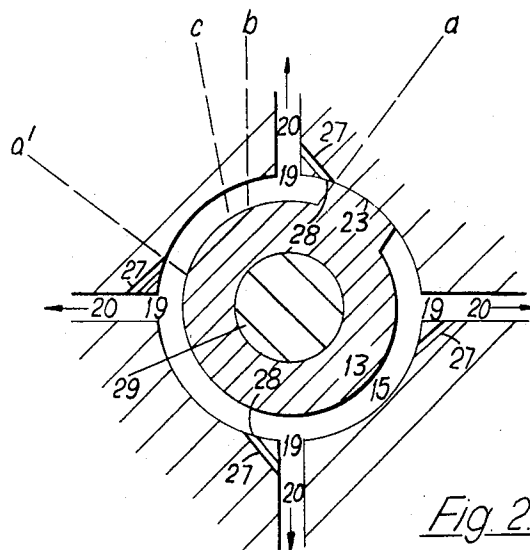
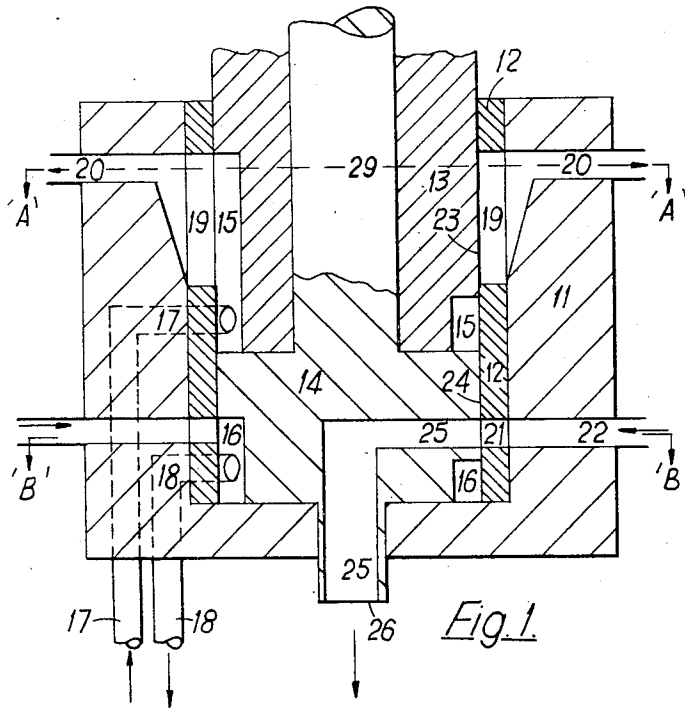
14 Claims, 10 Drawing Figures



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3,773,076

3 Sheets-Sheet 1



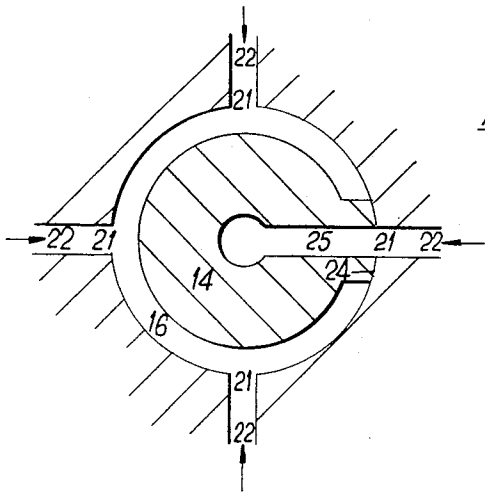


Fig. 3.

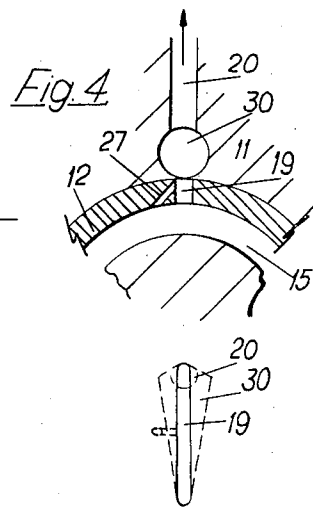


Fig. 5.

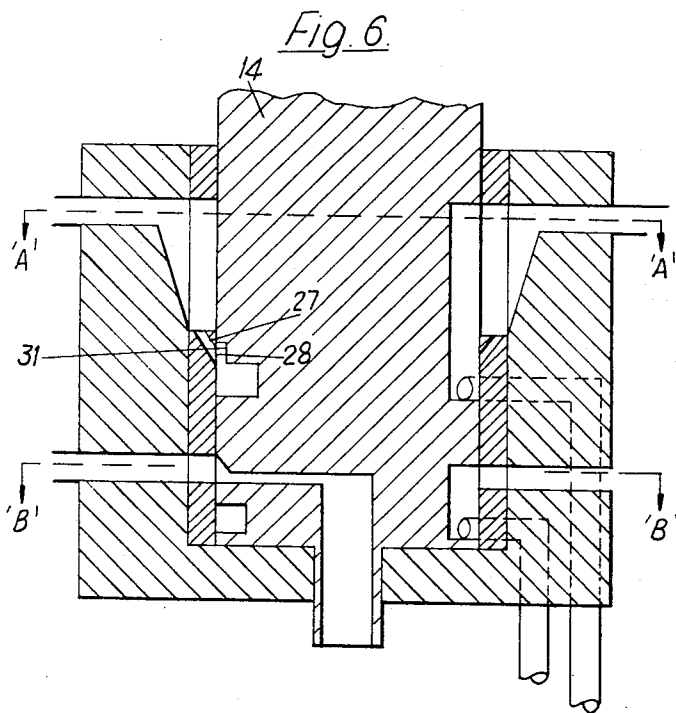
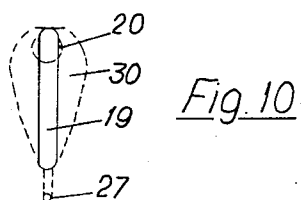
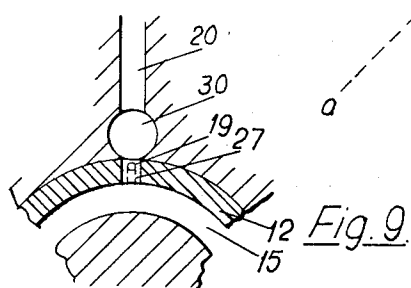
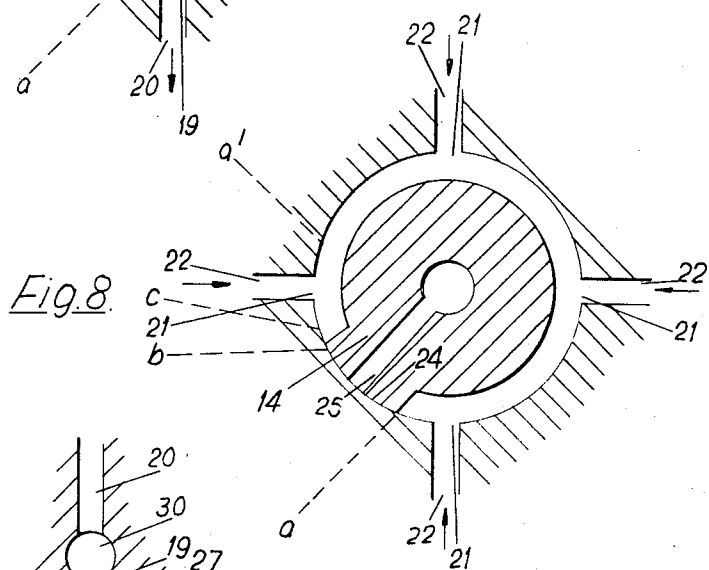
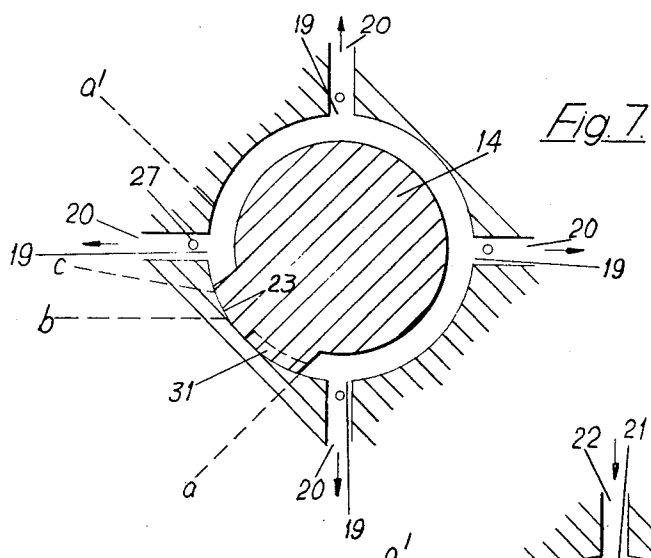


Fig. 6.



SELECTOR VALVE FOR RECEIVING & DISTRIBUTING PLURAL FLOWS

The present invention relates to valve means for controlling the distribution of a flow of liquid to and from a number of vessels.

According to the present invention we provide a valve comprising a valve body and at least one rotor, said valve body having a first chamber with primary inlet port and a plurality of outlet ports, a second chamber not in communication with said first chamber and having a plurality of secondary inlet ports and a secondary outlet port, said outlet ports and said inlet ports being equal in number, and said rotor or rotors being so designed and so oriented with respect to said valve body that in successive rotary positions said rotor effects closure individually of each of said outlet ports, and said or a second of said rotors effects closure individually of each of said inlet ports.

The valve of our invention may be used to control the supply by a primary feed of a number of sub-feeds of liquid, and one of said sub-feeds being interruptible by operation of said valve, each of said sub-feeds feeding a vessel external to said valve, said valve receiving an effluent flow from each of said vessels, said effluent flows and said sub-feeds being maintained separate, the flow of any one of said effluent flows to said valve being interruptible by operation of said valve, and said effluent flows being combined to provide a secondary feed.

In the valve according to our invention, interruption of sub-feeds may or may not, be independent of interruption of effluent flows.

In the valve according to our invention, by-passing means may be provided whereby when a sub-feed is interrupted a fraction of the normal sub-feed flow rate may be established. Diversionary means may also be provided whereby when an effluent flow is interrupted the whole of the effluent flow is then diverted to waste, that is, does not combine with the other effluent flows to form the secondary feed.

The valve according to our invention may comprise a valve body and first and second concentrically operating rotors. A primary feed passage through the body of the valve communicates with an annular passage between the first rotor and the valve body and from thence liquid is normally free to pass to each of a plurality of sub-feed ducts through the valve body. The first rotor has a closure surface so formed and so disposed with relation to the sub-feed ducts that on rotation it may effect closure of any one sub-feed duct. A by-pass aperture is also provided in the valve body associated with each of the sub-feed ducts, so formed and so disposed with relation to the first rotor that when closure of a sub-feed duct is effected, depending upon the position of the closure surface, the corresponding by-pass may optionally be closed. A secondary feed passage through the body of the valve communicates with an annular passage between the second rotor and the valve body and liquid from each effluent flow is normally free to flow into this annular passage through ducts passing through the valve body. The second rotor has a closure surface so formed and so disposed with relation to the effluent flow ducts that on rotation it may effect closure of any one effluent flow duct. The closure surface on the second rotor is provided with an aperture leading to a duct through the second rotor leading to waste, which when a particular effluent flow

duct is closed allows the whole of the normal effluent flow to pass from the effluent flow duct to waste.

The arrangement is such that the annular passage between the first rotor and the valve body is not in communication with the annular passage between the second rotor and the valve body.

It is only necessary to have one sub-feed feeding each vessel and only one effluent flow from each vessel, although there could be more than one of either or both, provided that closure was synchronised.

Preferably the threshold of the sub-feed ducts through the valve body should be narrower than the bore of the primary feed passage, so that any foreign body passing with the liquid through the primary feed duct will be held at the threshold of the sub-feed duct. The sub-feed duct threshold may, however, be elongated in order to minimise blockage of it by such foreign body with cessation of liquid flow. Such foreign body will with such a construction either be swept away from the threshold by movement of the rotor or its presence sensed on movement of the rotor, whereupon the foreign body may be removed by dismantling the valve after stopping the liquid feed to the valve.

Optionally the appropriate positions of each rotor may be indicated by visual coincidence of marks to indicate the required positions of the closure surfaces with relation to the sub-feed ducts and effluent flow ducts.

In order that on stopping one of the sub-feeds the change in the secondary feed should not be too great, we find it preferable to have at least three sub-feeds. A greater number than this, for example six or more, will be even more advantageous.

Optionally the degree of relative movement between the rotors may be limited so that, for example, the movement of one rotor to give a chosen position for its closure surface may result in one of two optional chosen positions for the closure surface of the other rotor.

The by-passing means allowing passage of a fraction of the normal sub-feed flow rate should preferably be so designed that under the conditions of flow to waste it passes a fraction of the normal sub-feed flow rate. The design of the by-passing means should be such as to take into account the fact that flow to waste will normally be to ambient pressure, whereas the normal flow will normally be to a pressure above ambient pressure, possibly much above ambient pressure. Thus for equal length of path of normal sub-feed and by-passing feed, the ratio of sub-feed aperture cross section to by-passing aperture cross-section will be greater than the ratio of normal sub-feed rate to by-passing feed rate. The by-passing flow should preferably be between a quarter and 1 of the normal sub-feed flow rate and more preferably between half and three quarters.

The valve according to our invention may, for example, be used to control the feed of a liquid to a plurality of filters operating effectively in parallel, allowing the isolation of any one filter at will to permit its replacement by a fresh filter without interruption of liquid feed through the remaining filters thus allowing the supply of filtered liquid to continue uninterrupted during the filter change. Moreover, in the case of a liquid which is to be supplied filtered and at a temperature other than ambient temperature, it is possible by the use of the valve of our invention after changing a filter to allow a fraction of normal flow rate of liquid to pass

through the filter by operation of the by-pass and to allow this fractional flow to run to waste until the desired stable conditions of the effluent flow from the newly changed filter have been achieved before operation of the rotors to allow full flow into the filter and to allow the effluent flow from the filter to join that from the other filters. Preferably the second rotor should be operated first allowing the fractional flow to join the effluent flows from the other filters before operating the first rotor to allow full flow through the fresh filter.

When the valve according to our invention is to be used for the control of the distribution of flow of a liquid which is thermally degradable, it is preferable that it should be so constructed that stagnant zones should be eliminated as far as possible. By a stagnant zone we mean a zone in which liquid tends to spend appreciably more than the average residence time for the liquid passing through the valve.

Specific embodiments of our invention will now be described with reference to the drawings in which:

FIG. 1 shows a section of a valve according to our invention, in elevation, and controlling four sub-feeds and four effluent flows,

FIG. 2 shows a section through A — A, showing particularly the first rotor and sub-feed ducts.

FIG. 3 shows a section through B — B, showing particularly the second rotor and effluent flow ducts,

FIG. 4 shows, in plan section, a sub-feed duct with long, narrow threshold,

FIG. 5 shows, in elevation, the threshold of FIG. 4.

FIG. 6 is a sectional view of an alternative valve;

FIG. 7 is a sectional view along the line A—A of FIG. 6;

FIG. 8 is a sectional view along the line B—B of FIG. 6;

FIG. 9 is a fragmentary sectional view illustrating a sub-feed duct with a long, narrow threshold; and

FIG. 10 is an elevational view of the threshold of FIG. 9.

Referring to FIGS. 1, 2 and 3, the valve comprises a valve body (11), a liner (12), onto which the valve body (11) is shrunk, and first (13) and second (14) concentrically disposed rotors each being a close fit, but allowing rotation, within the liner (12). An annular passage (15) is formed in the surface of the first rotor (13) and an annular passage (16) is formed in the surface of the second rotor (14). A primary feed duct (17) of 15 mm. diameter, is formed in the valve body (11) and communicates with the annular space (15) and a secondary feed duct (18) is formed in the valve body (11) and communicates with the annular space (16). Sub-feed ducts (19, 20) are formed from apertures (19) in the liner (12) and passageways (20) in the valve body (11). Effluent flow ducts (21, 22) are formed from apertures (21) in the liner (12) and passageways (22) in the valve body (11). The first rotor (13) has closure surface (23). The second rotor (14) has closure surface (24). A passageway (25) extends from the closure surface (24) to waste exit (26) and may be set in alignment with aperture (21). By-pass passageways (27) each of 1/16 inch diameter (1.59 mm) cross-section, are formed in the valve body (11). The by-pass apertures (28) and the apertures (19) are so sized and disposed, and the closure surface (23) so sized, that it is possible to close aperture (19) leaving by-pass aperture (28) open, to close both aperture (19) and by-pass

aperture (28), or to position closure surface (23) between adjacent apertures (19) without closure of any aperture (19) or aperture (28). The spindle extension (29) of the second rotor (14) forms a close fit within the first rotor (13) but allows relative rotary motion between the two rotors.

FIGS. 4 and 5 show a long, narrow version of threshold aperture (19) 5mm. in width and 80 mm. in length, communicating with a chamber (30) and thence to passageway (20).

In operation, a filter, not shown, is fitted so as to receive a flow of liquid from a passageway (20) and return it to the corresponding passageway (22). Thus there are four filters connected to the valve. The pressure drop in the liquid flow through a filter is arranged under the conditions of operation to be such that when the valve is operated so as to allow a flow of liquid only through the by-pass passageway (27) to a filter, and the valve is further operated so as to allow flow of the liquid which has passed through that filter to waste, then such flow to waste is half of the normal flow through the filter.

In operation, it may be assumed initially that liquid is flowing to all four filters. That is, the position of the closure surface (23) of the first rotor (13) is as shown in FIG. 2; its position is marked by the chain line at (a) and the closure surface (24) of the second rotor (14) is situated between apertures (21).

In order to change a filter the following steps occur:

1. The first rotor (13) is turned so that closure surface (23) covers an aperture (19) and corresponding by-pass aperture (27), (position marked by chain line at (b)).

2. The second rotor (14) is rotated so that closure surface (24) covers aperture (21) corresponding to the filter to be changed, aperture (21) is then in communication with passageway (25) leading to waste. The filter can then be changed.

3. After changing the filter, the first rotor (13) is rotated so that closure surface (23) still covers aperture (19) but the corresponding by-pass aperture (27) is uncovered (position marked by chain line at (c)). Thereupon liquid flows at reduced rate through the new filter and continues flowing to waste until the desired criteria of the effluent liquid are achieved.

4. When the desired criteria in the effluent liquid are achieved, the second rotor (14) is rotated so that closure surface (24) lies between adjacent apertures (21) so that effluent flow from the new filter enters the annular space (16) thus joining the effluent flows from the other filters.

5. The first rotor (13) is rotated so that closure surface (23) lies between adjacent apertures (19) so that no aperture (19) and no by-pass aperture (27) is covered (position marked by chain line at (a')); the full flow now passes through the newly changed filter and joins that from each of the other filters.

In the embodiment of FIGS. 6–10, there is a single rotor (14) bearing closure surfaces (23) and (24). The successive positions of the rotor (14) indicated by the positions (a), (b), (c) and (a') in FIG. 7 of necessity produce corresponding positions similarly indicated in FIG. 8.

The position of the rotor shown in FIG. 8 is analogous to that shown in FIG. 2. In changing a filter it is necessary only to turn the rotor to position (b) as marked, thus effecting steps (1) and (2) hereinbefore

described, then turn the rotor to position (c), which effects step (3) and finally turn the rotor to position a' which effects steps (4) and (5). Closure surface (23) has a recess (31) which uncovers by-pass apertures (28) when rotor (14) is in position (c), effecting step 3.

The valve depicted in FIGS. 6 to 10 has also the desirable feature that fluid pressure acting upwards and downwards on the rotor (14) is always approximately equalised, thus preventing excessive pressure between the bearing surfaces between the rotor (14) and the valve body (11) with consequent excessive friction causing difficulty.

What we claim is:

1. A valve comprising a valve body and rotor means within said body, said valve body having a first chamber with primary inlet port and a plurality of outlet ports, a second chamber not in communication with said first chamber and having a plurality of secondary inlet ports and a secondary outlet port, said outlet ports of said first chamber and said inlet ports of said second chamber being equal in number, and said rotor means being so designed and so oriented with respect to said valve body that in successive rotary positions said rotor means effects closure individually of each of said outlet ports of said first chamber, and in successive rotary positions said rotor means effects closure individually of each of said inlet ports of said second chamber.

2. A valve according to claim 1 wherein said rotor means is so designed that when closure of one of the outlet ports is effected a fraction of the normal flow through the outlet may be established.

3. A valve according to claim 2 wherein the fraction of the normal flow which is established when closure of one of the outlet ports is effected is between a quarter and the full flow.

4. A valve according to claim 3 wherein the fraction is between half and three quarters.

5. A valve according to claim 1 wherein said rotor means is so designed that when closure is effected of one of said inlet ports communication is effected with a waste outlet.

6. A valve according to claim 1 wherein the threshold of the outlet ports is narrower than the bore of the primary inlet port.

7. A valve according to claim 6 wherein the threshold

of the outlet ports is elongated.

8. A valve according to claim 1 wherein the number of outlet ports is at least three.

9. A valve according to claim 1 wherein the valve is so designed that stagnant zones are eliminated as far as possible.

10. A valve comprising: a valve body having a wall and an inner cavity, said wall being provided with a primary inlet port, a plurality of primary outlet ports, a plurality of secondary inlet ports equal in number to the primary outlet ports, and a secondary outlet port; rotor means within said cavity and defining with the wall of said valve body a first annular chamber which is in communication with the primary ports and a second annular chamber which is in communication with the secondary ports but not in communication with the first chamber, said rotor means having closure surfaces cooperating with the wall of said valve body in successive rotary positions to block communication between said first chamber and one of said primary outlet ports while leaving said first chamber in communication with the other primary outlet ports and simultaneously to block communication between said second chamber and one of said secondary inlet ports while leaving said second chamber in communication with the other secondary inlet ports.

11. A valve as in claim 10 including a by-pass passage of restricted flow capacity extending between said first chamber and each of said primary outlet ports, said rotor means cooperating with each by-pass passage to permit restricted flow from said first chamber into the respective primary outlet port when said rotor means is in a position blocking said respective primary outlet port.

12. A valve as in claim 10 wherein said rotor means includes a waste outlet passage having one end open through a closure surface of said rotor means so as to connect one of said secondary inlet ports to waste when said closure surface blocks communication between said second chamber and said one secondary inlet port.

13. A valve as in claim 10 wherein said rotor means includes independently rotatable first and second concentric rotor members.

14. A valve as in claim 10 wherein said rotor means is a single unitary rotor member.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,773,076 Dated November 20, 1973

Inventor(s) Frederick Arthur Smith

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

In the heading, line 30 was omitted and should appear as follows:

[30] Foreign Application Priority Data

Feb. 9, 1971 Great Britian 4257/71

In the Abstract, line 6 change "dishcarge" to --discharge--.

Col. 1, line 21 change "pf" to --of--.

Col. 3, line 16 change "BY" to --by-- (lower case).

Col. 4, line 2 change "withput" to --without--.

In The Claims:

Claim 2, line 3 for "if" insert --is--.

Signed and sealed this 9th day of April 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents