A valve arrangement has a valve housing (4) with a valve chamber (12) formed therein, which has an outlet (13) and an inlet (23) which is adapted to be connected to a pressure-medium source (1). A control valve (10, 26) is adapted, when in closed position, to close the outlet (13) of the valve chamber (12) and, when in open position, to open it. A main valve arranged in the valve housing has a valve member which is displaceable in the valve chamber and, depending on the pressure in the valve chamber, is shiftable between an outer closing position and an inner opening position. The valve member consists of a piston (22) freely displaceable in a circular-cylindrical portion (15) of the valve housing (4). The inlet of the valve chamber consists of an annular gap (23) between the piston (22) and the circular-cylindrical portion (15) of the valve housing (4).
FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT Austria
AU Australia
BB Barbados
BE Belgium
BF Burkina Faso
BG Bulgaria
BJ Benin
BR Brazil
CA Canada
CF Central African Republic
CG Congo
CH Switzerland
CI Côte d'Ivoire
CM Cameroon
CS Czechoslovakia
DE Germany
DK Denmark
ES Spain
FI Finland
FR France
GA Gabon
GB United Kingdom
GN Guinea
GR Greece
HU Hungary
IE Ireland
IT Italy
JP Japan
KP Democratic People's Republic of Korea
KR Republic of Korea
LI Liechtenstein
LK Sri Lanka
LU Luxembourg
MC Monaco
MG Madagascar
M1 Mali
MN Mongolia
MR Mauritania
MW Malawi
NL Netherlands
NO Norway
PL Poland
RO Romania
RU Russian Federation
SD Sudan
SE Sweden
SN Senegal
SU Soviet Union
TD Chad
TG Togo
US United States of America
1

VALVE ARRANGEMENT

The present invention relates to a valve arrangement having a valve housing with a valve chamber formed there-in, which has an outlet and an inlet which is adapted to be connected to a pressure-medium source; a control valve adapted, when in closed position, to close the outlet of the valve chamber and, when in open position, to open it; and a main valve having a valve member which is displaceable in the valve chamber and, depending on the pressure in the valve chamber, is shiftable between an outer closing position and inner opening position.

A known valve arrangement of this type is used for connecting compressed-air pulses to bag-shaped filter elements in a filtering plant for cleaning polluted gases. The compressed-air pulses are connected to the interior of the bag-shaped filter elements for cleaning these elements by striking or shaking loose dust which, in the cleaning of polluted gases, has attached to the walls of the filter elements. The valve arrangement is then mounted on a compressed-air tank. The wall of the compressed-air tank is formed with a through hole, via which the valve member of the main valve, when in closing position, extends into sealing engagement against a valve seat arranged in the compressed-air tank at one end of a pressure tube. This tube extends out from the compressed-air tank in order, when the valve member is temporarily moved to its inner opening position, to connect a compressed-air pulse to the interior of the filter element.

In this prior-art valve arrangement, the main valve has a circular membrane clamped between the valve housing and the wall of the compressed-air tank and covering the hole in the tank wall. The valve member is fixed on the outside of the membrane. It is surrounded by an annular membrane portion which has overflow through holes forming the inlet of the valve chamber and providing a connection between the compressed-air tank and the valve chamber. In
the known valve arrangement, the outlet of the valve chamber consists of an annular gap which opens at the outside of the valve housing. This gap is closed when the control valve is in its closed position, and open when the control valve is in its open position.

When the valve member of the main valve is in its closing position, it is maintained in engagement against the valve seat by the pressure prevailing in the valve chamber, which via the overflow holes in the membrane communicates with the compressed-air tank. Thus, the pressure in the valve chamber is the same as in the compressed-air tank, but since this pressure acts on a larger surface than does the pressure in the compressed-air tank, the membrane will be pressed out from the valve chamber, such that the valve member is urged towards its closing position.

When the control valve is opened, the air in the valve chamber flows out through the annular gap, and the pressure in the valve chamber drops, such that the pressure in the compressed-air tank urges the membrane into the valve chamber so as to open the main valve by moving the valve member to its inner opening position. When the control valve is closed shortly afterwards, the pressure in the valve chamber is again built up via the overflow holes in the membrane, whereby the main valve is closed by the valve member moving to its closing position.

In the known valve arrangement, the valve member is made of plastic and fixed to the outside of the membrane by means of a fixing bolt which extends through a plastic washer arranged at the inside of the membrane, through the membrane in its centre and through the valve member, and on which a nut is screwed. Thus, the main valve is quite complex in that it consists of many parts. Moreover, the fixing bolt and the nut are liable to corrosion in the environment where the filter element and, hence, the valve arrangement are used. As a result of corrosion, the fixing bolt, the valve member and the plastic washer will easily
come loose when subjected to vibrations. Also, the membrane is difficult to clamp between the valve housing and the wall of the compressed-air tank, since this mounting must be accurately adjusted to the stroke length of the membrane, that is the distance up to the valve seat on the pressure tube. The known valve arrangement also suffers from the drawback of the membrane easily breaking at the overflow holes.

The object of the present invention is to provide a new valve arrangement in which the main valve is of a considerably simpler design than the main valve of the known valve arrangement, has high corrosion stability, and is devoid of fracture areas in the form of overflow holes.

According to the present invention, this object is achieved by means of a valve arrangement which is of the type stated by way of introduction and which is characterised in that the valve body consists of a piston freely displaceable in a circular-cylindrical portion of the valve housing, and that the inlet of the valve chamber consists of an annular gap between the piston and the circular-cylindrical portion of the valve housing.

The circular-cylindrical portion of the valve housing preferably extends so far in the axial direction of the piston as to surround at least the major portion of and preferably the entire piston, seen in the axial direction thereof, also when the piston is in its closing position. Pressure-medium ports are suitably formed in the wall of the circular-cylindrical portion at the free end of this wall.

A preferred embodiment of the invention will now be described in more detail with reference to the accompanying drawings.

Fig. 1 is a sectional view showing a valve arrangement according to the present invention in closed position.
Fig. 2 is a sectional view showing the valve arrangement in open position.

The valve arrangement shown in Figs 1 and 2 is used for connecting compressed-air pulses to vertically arranged, bag-shaped filter elements (not shown) in a filtering plant for cleaning polluted gases. The valve arrangement is mounted on a pressure-medium tank 1 over a circular hole 2 provided in the upper wall of the tank. The tank 1 here is a compressed-air tank.

A vertical pressure tube 3, which is coaxial with the hole 2, extends through the lower wall of the compressed-air tank 1 into the tank and opens at a certain distance below the hole 2. The upper end of the pressure tube 3 forms a valve seat 3a, and its lower end 3b opens outside the tank 1 to be connected to the openings of the bag-shaped filter elements.

The valve arrangement has a valve housing 4 of aluminium, which consists of two circular, coaxial parts, namely an upper part 4a and a tubular, externally threaded lower part 4b, which are screwed together with intermediate spacer members (not shown). An internally threaded pipe socket 5, in which the lower part 4b is screwed, is welded in the hole 2. The lower part 4b has an annular upper flange 6 engaging the upper end of the pipe socket 5, when the lower part is screwed completely into the pipe socket. A sealing ring 7 is provided between the lower part 4b and the pipe socket 5.

The upper part 4a has a cup-shaped, circular recess 8 at its underside, and the lower part 4b has a cup-shaped, circular recess 9 at its upper side. A flat circular plate or disc 10 of flexible material, such as silicone rubber, is disposed between the two parts 4a and 4b in annular, sealing engagement against the walls of the two recesses 8 and 9 (Fig. 1). The disc 10 can be bent upwards into the position shown in Fig. 2, in which its sealing engagement with the wall of the recess 9 has been suspended and an annular communication 11 has been established between the
interior of the lower part 4b, this interior constituting the valve chamber 12 of the valve housing 4, and the annular gap 13 provided by the spacer members between the two parts 4a and 4b. The gap 13 communicates with the exterior of the valve housing 4.

The tubular lower part 4b has an upper portion 14, in which the recess 9 is formed, and a circular-cylindrical lower portion 15 having a larger inner diameter than the upper portion 14. An annular abutment 16 is formed between the two portions 14 and 15 of the lower part 4b. A rubber washer 17 engages the abutment 16 and is kept in place by means of a plastic washer 18 snapped into an annular groove 19 in the inner wall of the portion 15. This snap engagement is obtained by means of an annular groove 20 formed in the underside of the plastic washer 18 adjacent its periphery. A plurality of radial grooves 21 are also formed in the underside of the plastic washer 18.

A valve member in the form of a circular-cylindrical piston 22, having a substantially U-shaped longitudinal section, is disposed in the lower portion 15. The piston 22 is made of a glass-fibre-reinforced plastic and thus has good thermal and corrosion resistance. The outer diameter of the piston 22 is slightly smaller than the inner diameter of the lower portion 15, so as to provide an annular gap 23 between the piston 22 and the inner wall of the lower portion 15. The gap 23, which for greater clarity is shown with an exaggerated width in the drawings, provides a continuous communication between the interior of the pressure tank 1 and the valve chamber 12, and forms the inlet of the valve chamber. The piston 22 constitutes the main valve of the valve arrangement and is freely displaceable between an outer closing position, in which it sealingly engages the valve seat 3a of the pressure tube 3 (Fig. 1), and an inner opening position (Fig. 2), in which it is lifted off the valve seat 3a and in which it engages with its upper end the plastic washer 18, forming together with the rubber washer 17 a damping unit.
The upper part 4a has an axially oriented through bore 24 constituting an outlet from the recess 8. The upper part 4a has a radial groove 25 in its upper side. A solenoid valve 26, illustrated only schematically, is mounted on the upper part 4a in order, when in open position, to establish a communication between the bore 24 and the groove 25 and, when in closed position, to obstruct this communication. In the closed position of the valve arrangement (Fig. 1), the solenoid valve 26 is in closed position. The disc 10 has an overflow through hole 27 which provides a communication between the recess 8 and the valve chamber 12. The disc 10 and the solenoid valve 26 together form the control valve of the valve arrangement.

When the valve arrangement is to be opened from the closed position shown in Fig. 1, to connect a compressed-air pulse of short duration to the bag-shaped filter elements via the pressure tube 3, the solenoid valve 26 is opened so as to establish a communication between the recess 8 and the ambient atmosphere. The disc 10 is then bent into the position shown in Fig. 2. As a result, the outlet, formed of the communication 11 and the gap 13, of the valve chamber 12, is then opened (Fig. 2). The pressure in the valve chamber 12 is thereby reduced, such that the main valve is opened by the piston 22, forming the valve member, being moved to the position shown in Fig. 2, in which it engages the damping unit, consisting of the rubber washer 17 and the plastic washer 18, and in which the top opening of the pressure tube 3 has been exposed.

When the valve arrangement is to be closed from the open position shown in Fig. 2, the solenoid valve 26 is closed, such that a pressure is built up in the recess 8 via the hole 27 in the disc 10. The disc 10 is then returned to its flat position (Fig. 1), in which the outlet 11, 13 of the valve chamber 12 is closed. Through the gap 23 and the radial grooves 21 in the underside of the plastic washer 18, the pressure is then again built up in
the valve chamber 12, such that the main valve is closed.

As appears from the drawings, the circular-cylindrical lower portion 15 extends as far down as the upper end of the pressure tube 3, so that the entire piston 22, as seen in its axial direction, is surrounded by the portion 15, also when the piston is in its closing position. As a result, the piston 22 will be accurately guided during its entire displacement, thus obviating the risk of jamming. At its lower end, the portion 15 has a plurality of recesses 28 which prevent undesired throttling of the compressed air flow from the pressure tank 1 to the pressure tube 3 when the main valve is opened.
CLAIMS

1. Valve arrangement having a valve housing (4) with a valve chamber (12) formed therein, which has an outlet (11, 13) and an inlet (23) which is adapted to be connected to a pressure-medium source (1); a control valve (10, 26) adapted, when in closed position, to close the outlet of the valve chamber and, when in open position, to open it; and a main valve having a valve member (22) which is movable in the valve chamber and, depending on the pressure in the valve chamber, is shiftable between an outer closing position and an inner opening position, characterised in that the valve member consists of a piston (22) freely displaceable in a circular-cylindrical portion (15) of the valve housing (4), and that the inlet of the valve chamber consists of an annular gap (23) between the piston (22) and the circular-cylindrical portion (15) of the valve housing (4).

2. Valve arrangement as claimed in claim 1, characterised in that the circular-cylindrical portion (15) of the valve housing (4) extends so far in the axial direction of the piston (22) as to surround at least the major portion of the piston, as seen in the axial direction thereof, also when the piston is in its closing position.

3. Valve arrangement as claimed in claim 2, characterised in that the circular-cylindrical portion (15) of the valve housing (4) surrounds the entire piston (22), as seen in the axial direction thereof, when the piston is in its closing position.

4. Valve arrangement as claimed in claim 3, characterised in that pressure-medium ports (28) are formed in the wall of the circular-cylindrical portion (15) at the free end thereof.
INTERNATIONAL SEARCH REPORT

INTERNATIONAL APPLICATION No PCT/SE 92/00453

I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 16 K 7/17

II. FIELDS SEARCHED

Classification System
IPC5

Classification Symbols
F 16 K

Minimum Documentation Searched

Documentation Searched other than Minimum Documentation to the extent that such Documents are included in Fields Searched

SE, DK, FI, NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of Document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to Claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US, A, 4190230 (GEISSBUHLER) 26 February 1980, see the whole document</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>EP, A1, 0004526 (AB SVENSKA FLÄKT FABRIKEN) 3 October 1979, see abstract; figure 2</td>
<td>1</td>
</tr>
<tr>
<td>A,E</td>
<td>SE, B, 466362 (ABB FLÄKT AB) 3 February 1992, see abstract; figure 2</td>
<td>1-4</td>
</tr>
</tbody>
</table>

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the documents, either alone or in combination with one or more other such documents, such combination being obvious to a person skilled in the art.
- "Z" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search: 28th September 1992

Date of Mailing of this International Search Report: 05-10-1992

International Searching Authority: SWEDISH PATENT OFFICE

Signature of Authorized Officer: C. Westberg

Form PCT/ISA/210 (second sheet) (January 1985)
ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 92/00453

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 28/06/92. The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AU-B- 497809</td>
<td>79-01-11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AU-D- 1362676</td>
<td>77-11-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA-A- 1064835</td>
<td>79-10-23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH-A- 592466</td>
<td>77-10-31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE-A-B-C 2545252</td>
<td>76-11-18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FR-A-B- 2310148</td>
<td>76-12-03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB-A- 1538128</td>
<td>79-01-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP-C- 1027445</td>
<td>80-12-25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP-A- 51142167</td>
<td>76-12-07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP-B- 55018126</td>
<td>80-05-16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE-B-C- 414454</td>
<td>80-08-04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE-A- 7608089</td>
<td>76-11-06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AU-D- 4518179</td>
<td>79-09-20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA-A- 1102208</td>
<td>81-06-02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP-C- 1442233</td>
<td>88-05-30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP-A- 54136424</td>
<td>79-10-23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP-B- 62044149</td>
<td>87-09-18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE-B-C- 417239</td>
<td>81-03-02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE-A- 7803121</td>
<td>79-09-18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US-A- 4251048</td>
<td>81-02-17</td>
</tr>
</tbody>
</table>

SE-B- 466362                            | 92-02-03         | AU-D- 8056991           | 92-01-07        |
|                                        |                  | SE-A- 9002222           | 91-12-22        |
|                                        |                  | WO-A- 91/19922          | 91-12-26        |