

Valve device

The present invention concerns a valve device having the features of the classifying portion of claim 1 and/or the classifying portion of claim 15.

5 A valve device in accordance with the classifying portion of claim 1 is to be found in EP 1 123 155 B1. In that valve device the control diaphragm is actuated pneumatically, which limits the pressure range which can be used to very low pressures or requires large transmission areas.

 A valve device according to the classifying portion of claim 15 is to be found in
10 DE 195 42 797 B4. The device disclosed in that specification is of a very large structure. Control of the force storage means is effected by manual adjustment.

The object of the invention is to provide a valve device in which the above-described problems are at least partially avoided.

 That object is attained by a valve device having the features of claim 1 and/or
15 claim 15. Advantageous embodiments of the invention are recited in the appendant claims.

 The provision of a control chamber which is at least partially arranged in the valve housing for a substantially incompressible fluid (for example a liquid or a highly compressed gas) makes it possible to enlarge the pressure range which can be used
20 to much higher pressures than in the state of the art without large transmission areas being required. The invention affords pressure ranges of up to 100 bars instead of about 25 bars as in the state of the art. As the substantially incompressible fluid functions as a transmission fluid for the pressure generated by the pressure generating device, the pressure generating device can be arranged in any desired
25 fashion in relation to the closure element, which allows advantageous structural configurations.

 The provision of a controllable relief device by which the force exerted on the pressure transmission element by the force storage means can be reduced permits adjustment of the force by a control device so that manual adjustment is not required.

30 It should be noted that hereinafter the terms force and pressure are used interchangeably as conversion between force and pressure with a known area can be easily carried out.

 Embodiments of the invention are discussed with reference to the Figures in which:

Figure 1 shows a perspective view of an embodiment of a valve device according to the invention.

Figure 2a shows a sectional view through the valve device of Figure 1.

Figure 2b shows a sectional view along section line A-A in Figure 2a.

5 Figure 3 shows a modified state of the valve device as shown in Figure 2a, and

Figure 4 shows a sectional view through a further embodiment of a valve device according to the invention.

Figure 1 shows a perspective view of a proposed valve device, the sectional plane S of the sectional view of Figure 2a being shown here.

10 Figure 2a shows a valve housing 1 having a liquid feed 2 and a metering valve 3 having a discharge opening 5 closeable by a closure element 4. A liquid – for example a liquid plastic component of a single-component or multi-component plastic mixture – can be introduced into the metering valve 3 by way of the liquid feed 2.

The arrangement has a pressure control device which acts on the liquid in the
15 liquid feed 2 or in the metering valve 3. The pressure control device includes a control diaphragm 6 acting on the closure element 4. There is provided a shut-off diaphragm 7 which separates the pressure control device from the liquid feed 2 and from the metering valve 3. The shut-off diaphragm 7 is arranged at an end of the closure element 4, that is remote from the discharge opening 5. The pressure control device
20 has a fluid-tight control chamber 8 for a substantially incompressible fluid, the control chamber being arranged in this embodiment completely in the valve housing 1. As illustrated the shut-off diaphragm 7 is in the form of a plurality of individual diaphragms which are arranged sandwich-like. That is to be preferred over a thicker, single-layer configuration of a diaphragm. That can be effected in relation to all diaphragms.

25 There is provided a pressure generating device by which the control diaphragm 6 can be subjected to pressure by way of an incompressible fluid arranged in the control chamber 8.

The pressure control device includes a transmission element 24 arranged between the control diaphragm 6 and the closure element 4 for transmission of the
30 pressure acting on the control diaphragm 6 to the closure element 4. In this example the transmission element 24 is disposed between the control diaphragm 6 and the shut-off diaphragm 7 arranged on the closure element 4. The transmission element 24 which here is of a piston shape comprises a first element portion 24a connected to the closure element 4 and a second element portion 24b connected to the control
35 diaphragm 6. The mutually facing ends of the first element portion 24a and the

second element portion 24b bear against each other (for example in moment-free relationship by way of a spherical surface arranged therebetween, not shown), so that when pressure acts on the control diaphragm 6, that pressure can be transmitted to the closure element 4 by way of the second element portion 24b and the first element
5 portion 24a.

The pressure generating device has a pressure transmission element 10 which can be acted upon by a force storage means 9 (here in the form of a coil spring, it would also be possible to use other force storage means) and which in this embodiment is in the form of a plunger or piston. The pressure transmission element
10 10 acts on the control chamber 8 which here is closed off by means of a first rolling diaphragm 11.

There is provided a controllable relief device by which the force exerted on the pressure transmission element 10 by the force storage means 9 can be reduced. The controllable relief device here is in the form of a relief chamber 12 which can be filled
15 with a fluid under pressure. In the present embodiment the fluid is air. The fluid can be introduced into the relief chamber 12 by way of a fluid opening 13 and kept under an adjustable pressure, for example by way of a proportional pressure regulator. In the illustrated embodiment the fluid acts on a shoulder 14 of the pressure transmission element 10 and thus reduces the force exerted on the pressure transmission element
20 10 by the force storage means 9 by an adjustable amount. The force exerted on the pressure transmission element 10 by the force storage means 9 is therefore a maximum force which can be reduced to the desired extent in accordance with the respective setting of the pressure of the fluid.

The fluid pressure in the control chamber 8 arises out of the force exerted on
25 the first rolling diaphragm 11 by the force storage means 9, less the force acting in opposition to the force storage means 9, from the relief chamber 12. A force occurring due to the liquid which is flowing out acts on the shut-off diaphragm 7. The dimensioning of the shut-off diaphragm 7 and the control diaphragm 6 is so selected that the lower pressure of the fluid in the control chamber 8 (for example 30 bars) is in
30 equilibrium with the greater pressure which is produced by the liquid which is flowing out (for example 90 bars). That corresponds to a transmission ratio of 1:3. If pressure fluctuations occur the shut-off diaphragm 7 and the control diaphragm 6 can move (towards the left or the right in Figure 2a) in such a way that a fresh equilibrium is produced in the event of an increased or reduced gap between the closure element 4
35 and the discharge opening 5.

The present embodiment is fail-safe in relation to a failure of the pressure applied by the fluid insofar as, in the event of a failure, the discharge opening 5 is reliably closed by the closure element 4; if the pressure of the fluid in the relief chamber 12 fails then the force exerted on the pressure transmission element 10 by the force storage means 9 is not reduced. That force is of such a magnitude that it is sufficient to close the discharge opening 5 by the closure element 4.

In the illustrated embodiment the force storage means 9 is of a two-part structure: there are provided a first force storage means 91 and a second force storage means 92 which are connected in succession and which are respectively supported at a flange 16, that flange 16 being arranged on a slider 15 disposed displaceably on the pressure transmission element 10. The slider 15 is in contact with the pressure transmission element 10 by way of sliding bearings 17.

The pressure transmission element 10 has a head portion 19, wherein a second rolling diaphragm 18 is clamped between the head portion 19 and the shoulder 14.

Unlike the illustrated structure the element which seals off the control chamber 8 in relation to the pressure generating device or in relation to the head portion 19 of the pressure transmission element 10 of the pressure generating device or the element sealing off the relief chamber 12 in relation to the shoulder 14 of the pressure transmission element 10 does not have to be in the form of a rolling diaphragm. Alternatively it is possible to use flat diaphragms or piston seals.

A preferably pneumatically actuable adjusting element 20 is provided for completely closing the discharge opening 5 by means of the closure element 4. If as described above failure of the pneumatic system occurs reliable closure of the discharge opening 5 by the adjusting element 20 would not be guaranteed. The above-described fail-safe aspect however takes effect.

Figure 2b shows a sectional view through the metering valve 3 along section line A-A in Figure 2a. In this embodiment the closure element 4 has projections 21 which bear against an internal casing 22 of the metering valve 3 and by way of which it is secured against radial deviation in relation to the discharge opening 5 which in this case is nozzle-shaped.

It will be seen from Figure 3 that in this example the valve housing 1 includes two valve housing portions, namely a first valve housing portion 1a and a second valve housing portion 1b which can be releasably connected to the first valve housing portion 1a. In the illustrated view the first valve housing portion 1a and the second

valve housing portion 1b are shown detached from each other. The metering valve 3, the discharge opening 5, the closure element 4, the liquid feed 2 and the shut-off diaphragm 7 are arranged in the first valve housing portion 1a and the control chamber 8, the control diaphragm 6, the relief chamber 12, the pressure transmission element 10 and the force storage means 9 are arranged in the second valve housing portion 1b.

The first element portion 24a of the two-part transmission element 24 is arranged in an opening in the first valve housing portion 1a. The second element portion 24b is arranged in the second valve housing portion 1b. A free end of the second element portion 24b projects out by way of the surface of the second valve housing portion 1b. Connection of the second valve housing portion 1b to the first valve housing portion 1a can be facilitated by the free end of the second element portion 24b being introduced into the opening in the first valve housing portion 1a.

Figure 4 shows a sectional view as in Figure 2a illustrating a further embodiment of a proposed valve device. In this example the valve device includes a valve housing 1 which is of a three-part structure, including a first valve housing portion 1a, a second valve housing portion 1b and a third valve housing portion 1c. Arranged in the first valve housing portion 1a are the metering valve 3, the discharge opening 5, the closure element 4, the liquid feed 2, the shut-off diaphragm 7 and the first element portion 24a of the two-part transmission element 24. Connected to the first valve housing portion 1a is the second valve housing portion 1b in which the second element portion 24b, the control diaphragm 6 and a third control chamber region 8c of the control chamber 8 are arranged. The pressure generating device (pressure transmission element 10, force storage means 9), the relief device (relief chamber 12) and a first control chamber region 8a are arranged in the third valve housing portion 1c. The first rolling diaphragm 11 which is also arranged in the third valve housing portion 1c delimits the first control chamber region 8a in relation to the pressure generating device. The first control chamber region 8a is connected to the third control chamber region 8c in the second valve housing portion 1b by way of a conduit 23 which forms a second control chamber region 8b. In this example the first control chamber region 8a, the second control chamber region 8b and the third control chamber region 8c jointly form the control chamber 8 of the valve device.

List of references:

	1	valve housing
	1a	first valve housing portion
	1b	second valve housing portion
5	1c	third valve housing portion
	2	liquid feed
	3	metering valve
	4	closure element
	5	discharge opening
10	6	control diaphragm
	7	shut-off diaphragm
	8	control chamber
	8a	first control chamber region
	8b	second control chamber region
15	8c	third control chamber region
	9	force storage means
	91	first force storage means
	92	second force storage means
	10	pressure transmission element
20	11	first rolling diaphragm
	12	relief chamber
	13	fluid opening
	14	shoulder
	15	slider
25	16	flange
	17	sliding bearing
	18	second rolling diaphragm
	19	head portion of the pressure transmission element 10
	20	adjusting element
30	21	projections
	22	internal casing
	23	conduit
	24	transmission element
	24a	first element portion
35	24b	second element portion

CLAIMS

1. A valve device for liquid plastic components of single-component or multi-component plastic mixtures, comprising a valve housing (1) having a liquid feed (2) and a metering valve (3) having a discharge opening (5) closeable by a closure element (4), a pressure control device acting on the liquid in the liquid feed (2) and including a control diaphragm (6) acting on the closure element (4), and a shut-off diaphragm (7) which separates the pressure control device from the liquid feed (2), characterised in that the pressure control device includes a fluid-tight control chamber (8) for a substantially incompressible fluid, that is arranged at least partially in the valve housing (1), wherein there is provided a pressure generating device by which the control diaphragm (6) can be acted upon with pressure by way of an incompressible fluid arranged in the control chamber (8).

2. A valve device as set forth in claim 1 wherein the shut-off diaphragm (7) is arranged at the closure element (4), preferably at an end of the closure element (4), that is remote from the discharge opening (5).

3. A valve device as set forth in claim 1 or claim 2 wherein the pressure control device includes a transmission element (24) arranged between the control diaphragm (6) and the closure element (4) for transmission of a pressure acting on the control diaphragm (6) to the closure element (4).

4. A valve device as set forth in claim 2 and claim 3 wherein the transmission element (24) is arranged between the control diaphragm (6) and the shut-off diaphragm (7).

5. A valve device as set forth in at least one of the preceding claims wherein the control chamber (8) is closed off with respect to the pressure generating device by a first seal, preferably a first rolling diaphragm (11).

6. A valve device as set forth in at least one of the preceding claims wherein the pressure generating device has a force storage means (9) and a pressure transmission element (10) which can be acted upon by the force storage means (9).

7. A valve device as set forth in claim 6 wherein the force storage means (9) is in the form of a coil spring.

8. A valve device as set forth in claim 6 or claim 7 wherein the force storage means (9) is of an at least two-part configuration.

9. A valve device as set forth in claim 8 wherein the force storage means (9) includes a first force storage means (91) and a second force storage means (92) which are connected in succession, wherein preferably the first force storage means (91) and the second force storage means (92) are respectively supported at a flange (16) of a slider (15) arranged displaceably on the pressure transmission element (10).

10. A valve device as set forth in at least one of the preceding claims wherein the valve housing (1) is of an at least two-part configuration.

11. A valve device as set forth in claim 10 wherein the valve housing (1) includes a first valve housing portion (1a) and a second valve housing portion (1b), wherein the first valve housing portion (1a) can be releasably connected to the second valve housing portion (1b).

12. A valve device as set forth in claim 11 wherein arranged in the first valve housing portion (1a) are at least the metering valve (3), the discharge opening (5), the closure element (4), the liquid feed (2) and the shut-off diaphragm (7).

13. A valve device as set forth in claim 11 or claim 12 wherein arranged in the second valve housing portion (1b) are at least the control diaphragm (6) and the control chamber (8) and preferably also the pressure generating device.

14. A valve device as set forth in claim 11 or claim 12 wherein the valve housing (1) includes a third valve housing portion (1c) in which the pressure generating device and a first control chamber region (8a) are arranged, wherein arranged in the second valve housing portion (1b) are the control diaphragm (6) and a third control chamber region (8c) which is connected to the first control chamber region (8a) by way of a conduit (23) forming a second control chamber region (8b), wherein

the first control chamber region (8a), the second control chamber region (8b) and the third control chamber region (8c) jointly form the control chamber (8).

5 15. A valve device as set forth in one of claims 1 through 14 wherein the pressure generating device has a pressure transmission element (10) which can be acted upon by a force storage means (9), wherein there is provided a controllable relief device by which the force exerted on the pressure transmission element (10) by the force storage means (9) can be reduced.

10 16. A valve device as set forth in claim 15 wherein the relief device includes a relief chamber (12).

15 17. A valve device as set forth in claim 16 wherein a fluid opening (13) opens into the relief chamber (12), by way of which fluid opening a fluid under pressure – preferably air – can be introduced into the relief chamber (12).

 18. A valve device as set forth in claim 16 or claim 17 wherein the pressure transmission element (10) has a shoulder (14) which delimits the relief chamber (12).

20 19. A valve device as set forth in at least one of claims 16 through 18 wherein the relief chamber (12) is at least partially closed off with respect to the pressure transmission element (10) by a second seal, preferably a second rolling diaphragm (18).

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