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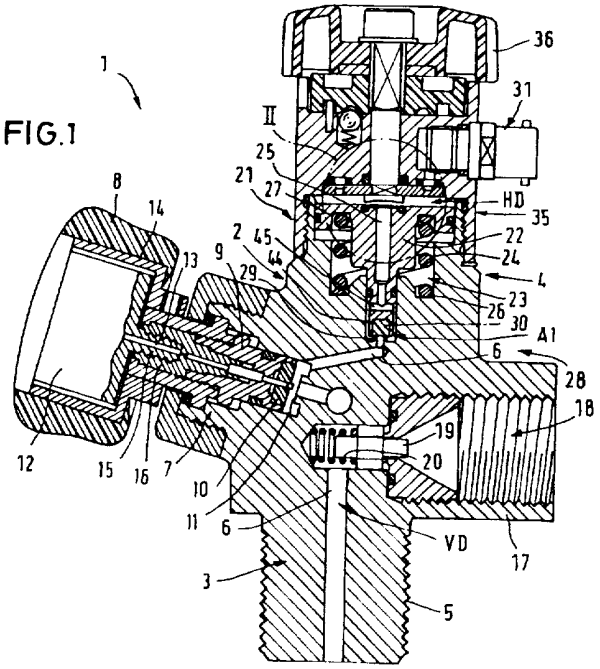
(54) Abstract Title
Pressure regulating valve

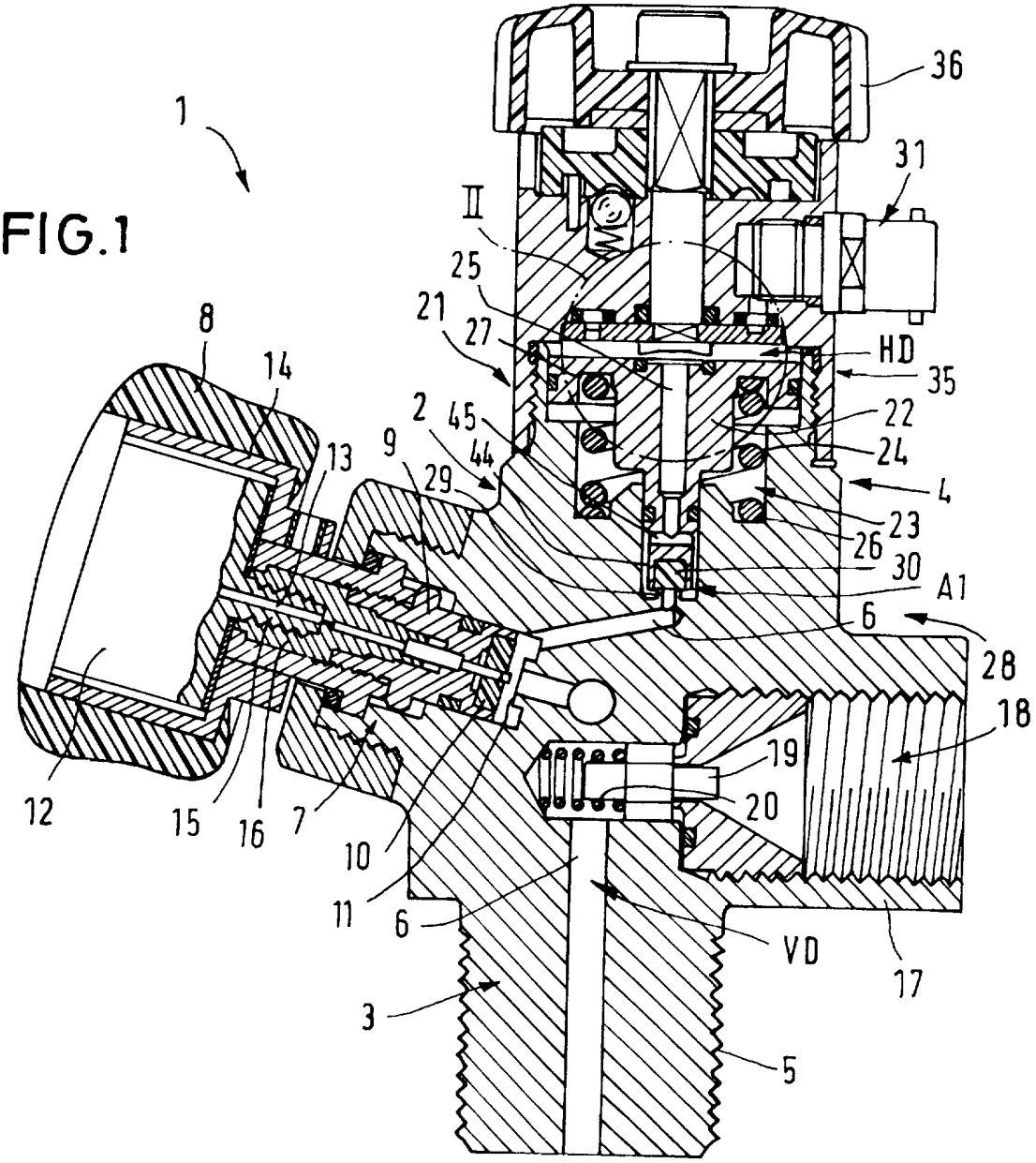
(57) A valve for a pressure container comprises housing 2, container connector 3, delivery connector 31, fluid channel 6 closeable by shut-off valve 7 and an integrated regulating valve 21 that closes when a residual pressure in the container falls below a set value. Valve 21 comprises valve member 22 with fluid passage 25 biased closed against valve seat (43, figure 2) on the outlet side of member 22 by spring 24 and sealing element 30 on the inlet side of member 22 which cooperates with a second valve seat 29 to close passage 25. Member 22 is preferably a stepped plunger and spring 24 is preferably a helical compression spring. Seat (43) is preferably closed by an O-ring (40) embedded in annular groove (42) in member 22 which encircles fluid passage 25. The fluid flow rate from outlet 31 may be adjusted by selector plate (32) using handwheel 36. Shut-off valve 7 may comprise a non-rotatable pressure gauge 12 in handwheel 8. Non-return valve 18 may be provided to allow the pressure container to be filled.

FIG.1



GB 2 349 200 A

FIG.1


1
36
31
II
25
21
27
HD
35
8
14
22
2
45
24
44
13
9
29
4
23
26
30
A1
6
28
18
19
20
12
15
16
7
10
11
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VD
17
3
5

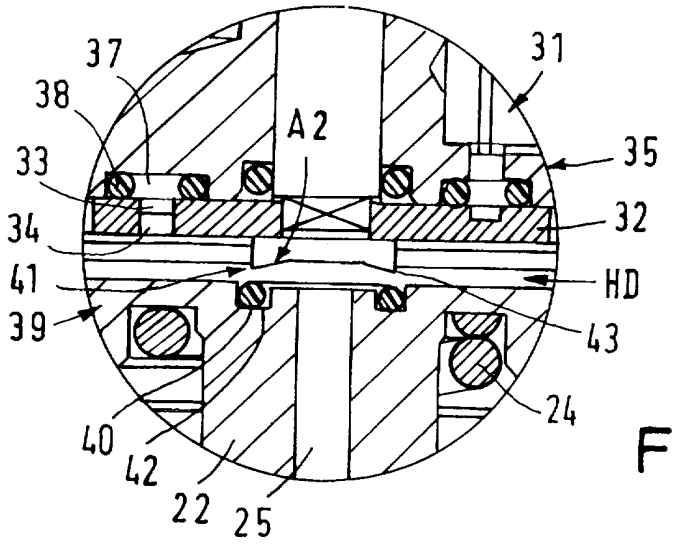
37
31
38
A2
35
33
32
34
41
HD
39
43
24
40
42
22
25

FIG.2

"Valve Fitting for a Pressure Container"

This invention relates to a valve fitting for a pressure container which comprises a valve housing with a container connector and a delivery connector connected by a fluid channel which is closable by a shut-off valve, and an integrated regulating valve which comprises a valve body with a fluid passage under the influence of a control spring, whereby a valve seat and a first sealing element are arranged on the side of the valve body facing the supply pressure region and are movable relative to one another to separate the supply pressure region and the relieved pressure region.

Pressure containers, in particular high pressure gas bottles, serve to receive and supply different gases. The pressure containers hold the gases either in the gaseous state at high pressures or, for example in the case of carbon dioxide, as liquid under pressure. Other gases, for example acetylene, are dissolved in an absorption medium, such as acetone, under pressure in the container to avoid the danger of explosion.

Valve fittings with pressure regulators are used for the establishment and/or regulation of a relieved pressure which is low compared to the high supply pressure existing in the pressure container. Such a valve fitting is shown to be state of the art, for example by DE 34 41 348 A1. The valve fitting comprises a pressure-reducing valve incorporated in the valve housing and a pressure regulator with a control spring.

The pressure regulator reduces the static pressure on the delivery side (relieved pressure region). As long as a pressure medium can flow through the

valve, the control spring holds the valve open and the valve body is raised. On closing of the valve, a pressure arises on the delivery side in the relieved pressure region, which together with the active surfaces of the valve body and the control spring moves the valve body into its closure position and thus closes the valve. The maximum pressure in the relieved pressure region may be set by changing the spring bias.

Often supplied in pressure containers are special gases which should not be mixed with other gases or air on safety grounds or on account of their specific use, for example as pure gases in engineering, as medical gases or as diving gases. On these grounds the pressure containers are provided with valve fittings which possess integrated residual pressure valves.

A valve fitting with integrated residual pressure valve is, for example, known in the art from EP 0 458 253 B1 or DE 197 09 096 A1. The residual pressure valve is constructed in the form of a non-return valve. With an inner pressure higher than the set residual pressure, it is lifted from its valve seat and thus opened. When the residual pressure falls short, the residual pressure valve closes under spring activation. The residual pressure valve thus prevents complete exhaustion of pressure in the pressure container with an open delivery valve, as soon as the inner pressure of the gas falls below a predetermined minimum pressure. In this way, it is ensured that the pressure container does not have to be evacuated or washed for each new filling. Moreover, the residual pressure valve prevents the ingress of foreign substances from outside.

The known designs of valve fittings have in general been successful. They have been steadily further developed over the course of time. Nevertheless, it is desirable to construct valve fittings more compactly and more simply.

Starting from the state of the art, the invention is based on the problem of providing a pressure regulating valve fitting with residual gas pressure closure which is simple to construct and manufacture and is convenient in operation.

Accordingly, the invention provides a valve fitting for a pressure container which comprises a valve housing with a container connector and a delivery connector connected by a fluid channel which is closable by a shut-off valve, and an integrated regulating valve which comprises a valve body with a fluid passage under the influence of a control spring, whereby a valve seat and a first sealing element are arranged on the side of the valve body towards the supply pressure region and are movable relative to one another to separate the supply pressure region and the relieved pressure region, in which a sealing seat co-operating with a second sealing element is provided on the delivery side of the valve body, whereby the second sealing element closes the fluid channel in the relieved pressure region by displacement against the sealing seat upon the residual pressure in the pressure container falling short.

Central to the invention is the step of providing the regulating valve with a second sealing element on the delivery side of the valve body near the sealing element in the supply pressure region, which co-operates with a sealing seat and by engaging the sealing seat closes the fluid channel in the relieved pressure region when the residual pressure in the pressure container falls short.

The residual pressure can be determined by construction. It is dependent on the spring force of the control spring and its spring characteristic

as well as the spacing between the valve body and the sealing seat. It is also possible to arrange the valve fitting so that the residual pressure is adjustable.

The functions of the regulating valve and the residual pressure valve are structurally brought together in the valve fitting construction according to the invention and are realised in one valve body. According to the invention, the deflection of the control spring acting on the valve body is used to operate or close the residual pressure valve.

As soon as the supply pressure falls below the relieved pressure, the control spring of the control valve expands and moves the valve body in translation. As a result the second sealing element comes into abutment with the co-operating sealing seat and seals off the supply pressure region from the atmosphere.

In this way it is possible to achieve a residual gas pressure closure in a valve with integrated pressure regulator without using additional components. The residual gas pressure closure prevents the pressure container being completely emptied through the delivery connection. It is thereby ensured that the pressure in the pressure container is always higher than the atmospheric pressure. A gas exchange with the environment is thus prevented. As a consequence there is also prevention of ingress of air humidity, which can lead to corrosion in the pressure container, and the purity of the pressure medium to be stored in the pressurised container is ensured. Conventional evacuation procedures before the filling of the pressure container can be eliminated.

The valve fitting according to the invention is advantageous in manufacture, since additional bores to accept a separate residual pressure valve

are eliminated. Also, the valve fitting promises many advantages in practice as regards the assembly of the unitary parts and maintenance.

The control spring can basically be embodied as various kinds of elastic elements, for example as a pneumatic spring. Further diverse structures are possible for the valve body, for example as plungers or membranes.

In an advantageous development of the basic inventive concept, the valve body is formed by a stepped plunger guided in a bore and a helical compression spring is employed as the control spring. This structure works reliably without vibration and is readily adjustable.

The second sealing element can be formed in various ways, for example as a vulcanised sealing layer on the valve body made from elastomer or similar sealing materials.

Conveniently, the second sealing element is an O-ring embedded in an annular groove encircling the fluid passage, which O-ring co-operates with a sealing seat formed by an annular bead on the valve housing.

This refinement is simple to manufacture and assemble. In order to achieve the residual gas pressure closure there is only required an O-ring and the annular bead serving as the sealing seat.

In order that the invention may be more readily understood, an embodiment thereof will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a valve fitting embodying the invention in vertical cross-section; and

Figure 2 is an enlarged view of the portion II of Figure 1.

A valve fitting 1shown in Figure 1 can be connected to a pressure container (gas bottle) which is not illustrated. The valve fitting 1 comprises a multi-part valve housing 2 with a container connector 3 and a delivery connector 4. To secure the valve fitting 1 to a pressure gas container, a threaded portion 5 of the container connector 3 is tightly screwed into a corresponding threaded bore of the pressure gas container. The gas connection between the container connector 3 and the delivery connector 4 from the supply pressure region VD to the relieved pressure region HD is formed by a fluid channel 6 constructed from several sections of longitudinal, transverse and inclined bores.

A shut-off valve 7 is installed in the valve housing 2. The operation of the shut-off valve 7 is effected by a hand-wheel 8. By rotating the hand-wheel 8 a closure element 9 with a sealing insert 10 can be engaged with a main valve seat 11 or raised from the main valve seat 11. In this way the fluid channel 6 is closed or opened.

A pressure gauge 12 is integrated into the hand-wheel 8, which pressure gauge is connected via a capillary bore 13 with the fluid channel 6. In this way the pressure in the supply region VD of the valve fitting 1 can be brought to the indicator.

In contrast to the rotatably moveable hand wheel 8, the pressure gauge 12 is stationary. To this end, the pressure gauge 12 is received in a pressure gauge holder 14 which is screwed by a threaded spigot 15 into the outer valve spindle 16 and is non-rotatably secured therein.

For the filling of the pressure container, the valve fitting 1 comprises a filling connector 17 with an integrated non-return valve 18. In order to fill the pressure container, the closure body 19 of the non-return valve 18 is pressed back against the force of a spring 20 arranged in a transverse bore forming part of the fluid channel 6 and the pressure container can be filled through the lower part of the fluid channel 6. At the end of the filling procedure the non-return valve 18 closes automatically.

A control valve 24 is also installed in the valve housing 2. The control valve 21 separates the supply pressure region VD and the relieved pressure region HD of the valve fitting 1. The control valve 21 comprises a valve body in the form of a stepped plunger 22 which is guided in a correspondingly stepped bore 23 and co-operates with a control spring 24. A helical compression spring is used as the control spring 24. The plunger 22 is pierced centrally by a fluid passage 25.

The control spring 24 has one end engaged in a recess 26 forming part of the bore 23 in the valve housing 2 and its other end in a recess 27 of the plunger 22.

A valve seat 29 and a first sealing element 30 are arranged at the end 28 of the plunger 22 towards the supply pressure region VD. The sealing element 30 is moveable against the valve seat 39 together with the plunger 22. With the plunger 32 or sealing element 30 abutting the valve seat 29 the resulting spring force determines the pressure existing in the relieved pressure region HD.

Gas can be extracted through a relieved pressure outlet 31. The relieved pressure and the prevailing flow rate is adjustable. To this end, the relieved pressure outlet 31 is connected to the relieved pressure region HD at the delivery end 35 of the valve body 22 through a groove 33 and a bore 34 in a selector plate holder 32 (see Figure 2 in this connection). The selector plate holder 32 is rotatably mounted in the valve housing 2 and is actuated via a hand-wheel 36 which takes up defined rest positions. A selector plate 37 is arranged between the selector plate holder 32 and the valve housing 2 and is fixed against rotation opposite the selector plate holder 32. The selector plate 37 is provided with apertures of different cross-sections, whereby the flow rate at the relieved pressure outlet 31 is controllable. The selector plate 37 is therefore also called a flow rate selecting plate. The relieved pressure outlet 31 can also be closed by the selector plate 37. The selector plate 37 is supported in the valve housing 2 by slide rings 38 which on the one side seal the relieved pressure region HD and on the other side serve as a sliding bearing.

A residual gas pressure closure is achieved with the assistance of the plunger 32 of the regulating valve 21. To this end, the plunger 22 possesses on the delivery side, thus at the end 39 towards the selector plate 37, a second sealing element 40 which co-operates with a sealing seat 41. When the pressure falls below a selectable minimum pressure in the pressure container, the sealing element 40 closes the fluid channel 6 in the relieved pressure region HD by contacting the sealing seat 41. The residual pressure is dependent on the spring force of the control spring 21 and its spring characteristic as well as the spacing between the plunger 22 and the valve seat 41.

As is indicated more particularly in Figure 2, the second sealing element 40 is an O-ring embedded in an annular groove 42 extending circumferentially

around the fluid passage 25. The sealing seat 41 is formed by an annular bead 43 in the valve housing 2 below the selector plate holder 32.

When pressure is admitted and with gas flowing through the relieved pressure outlet 31, equilibrium is established between the forces arising from the supply pressure acting on the plunger surface A1 at the valve seat 29, from the relieved pressure acting on the plunger surface A2 at the sealing seat 41 and from the control spring 24. The plunger 22 is lifted from the valve seat 29 and gas flows through it. The gas passes through the annular space 44 between the first step of the bore 23 and the first step of the plunger 22 through transverse openings 45 in the fluid passage 25 to the relieved pressure outlet 31. If the gas flow is interrupted, for example by means of the selector plate 37, the force equilibrium is removed and the resulting force of the relieved pressure on the surface A2 prevails. The plunger 22 is displaced against the valve seat 29 and the surface A1 is sealed against the supply pressure.

If, on extraction of gas, the supply pressure falls below the relieved pressure established by the surface proportions A1/A2, the supply pressure and the spring force, the spring force of the control spring 24 prevails. This expands and moves the plunger 22 in translation upwardly against the sealing seat 41 in the plane of the drawing. The gas flow is thus interrupted. The supply pressure region VD is sealed against the atmosphere. Accordingly, a residual gas pressure closure is achieved on the delivery side of the valve body 22 by means of the sealing element 40 and the sealing seat 41 arranged there. It is thereby ensured that the pressure container cannot be completely emptied through the relieved pressure outlet 31. The purity of a gas in the pressure container is guaranteed and the usual evacuation before refilling is not necessary.

CLAIMS

1. A valve fitting for a pressure container which comprises a valve housing with a container connector and a delivery connector connected by a fluid channel which is closable by a shut-off valve, and an integrated regulating valve which comprises a valve body with a fluid passage under the influence of a control spring, whereby a valve seat and a first sealing element are arranged on the side of the valve body towards the supply pressure region and are movable relative to one another to separate the supply pressure region and the relieved pressure region, in which valve fitting a sealing seat co-operating with a second sealing element is provided on the delivery side of the valve body, whereby the second sealing element closes the fluid channel in the relieved pressure region by displacement against the sealing seat upon the residual pressure in the pressure container falling below a predetermined pressure.

2. A valve fitting according to Claim 1, in which the valve body is in the form of a stepped plunger guided in a bore and a helical compression spring is employed as the control spring.

3. A valve fitting according to Claim 1 or 2, in which the second sealing element is an O-ring embedded in an annular groove encircling the fluid passage, which O-ring co-operates with an annular bead on the valve housing forming the sealing seat.

4. A valve fitting substantially as hereinbefore described with reference to the accompanying drawings.

Application No:	GB 0008132.3	**Examiner:**	Darren Handley
Claims searched:	1 - 4	**Date of search:**	22 June 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): F2V (VA6, VR3, VV12)

Int Cl (Ed.7): F16K 1/44; G05D 16/10

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2308425A	(GAS) - see page 4, line 8- page 5, line 2.	1, 2
X	US 4083380A	(HUBER) - see column 2, line 61- column 4, line 14.	1-3

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.