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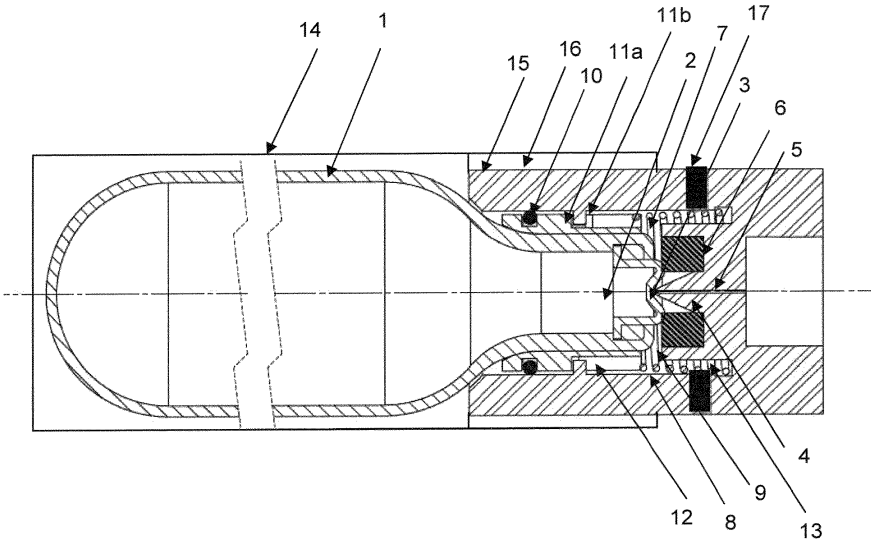
A request for correction of the drawings (figur 3) has been filed pursuant to Rule 139 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) **Safety sealing connecting device for gas cylinder**

(57) A sealing device comprising,
- a piercing housing for holding a gas cylinder with a top surface comprising a gas outlet
- the piercing housing comprising side walls and a bottom wall which is vertical to the axis of the cylinder
- a piercing member arranged in the piercing housing for piercing the gas outlet of the cylinder

and at least one first seal assembly to form a seal for the pierced top surface of the cylinder between the bottom wall of the piercing housing and the top surface of the cylinder and at least one second seal assembly to form a seal between the side walls of the piercing housing and the cylinder. At least one bayonet mount with a male part and a female part is provided for connecting the cylinder with the piercing housing.

Fig.1



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Description

[0001] The present invention relates to a sealing device comprising,

- a piercing housing for holding a gas cylinder with a top surface comprising a gas outlet
- the piercing housing comprising side walls and a bottom wall which is vertical to the axis of the cylinder
- a piercing member arranged in the piercing housing for piercing the gas outlet of the cylinder

and at least one first seal assembly to form a seal between the bottom wall of the piercing housing and the top surface of the cylinder and at least one second seal assembly to form a seal between the side walls of the piercing housing and the cylinder.

[0002] Such a sealing device is mostly used for a gas supply system which delivers a pressurized gas from a cylinder to a user. Gases are frequently supplied in cylinders where the gas is held within a cavity defined by the cylinder walls being enclosed at one end by a pierceable diaphragm. The gas is able to be delivered from the cylinder by attaching a piercing element to the cylinder which causes the diaphragm to be pierced and for the gases to be released from the cylinder. The piercing element is usually connected with a channel such as a tube or hose which leads to the user. Before reaching the user the gas flow has to be controlled by one or more valves to meet the requirements of the user. The gas from the cylinder should only flow into the channel, so it is necessary for a seal to be formed between the cylinder and the piercing element.

[0003] As disclosed in US2012/0073674 a gas supply system is provided with a cylinder containing gas closed by a piercing diaphragm, a spacer element adjacent the diaphragm , the spacer element having a channel providing access to the diaphragm, a shaft with a piercing tip, and a seal, wherein the shaft, spacer element and seal are arranged so that when the shaft accesses the diaphragm via the channel, the shaft is caused to enter into a sealing engagement with the spacer element via the seal before the piercing tip pierces the diaphragm. In an alternative embodiment, no spacer element is provided and instead a seal is provided in a groove in a wall defining a recess at a position so that when a gas cylinder is inserted into the recess, the seal enters into a sealing engagement with the gas cylinder before the piercing tip of the shaft pierces the diaphragm.

[0004] Problems can, when a user screws the cylinder off from the piercing housing for changing or by mistake, if there is still gas remained in the cylinder with high pressure which would be dangerous for the user, then the cylinder can be pushed back by the remaining pressure and can fly off suddenly after the cylinder is not locked by the screw any more. The force exerted by the pressure of gas acting against the area of the housing can be so large to cause an injury as well as damage.

[0005] It is therefore desirable to protect the gas cylinder from being propelled accidentally by high pressure and ensure that the gas cylinder can only be removed from the piercing housing when the pressure in the housing has reduced to a safe value.

[0006] This problem can be solved by a sealing device according to claim 1.

[0007] The present invention provides a sealing device comprising a piercing housing and a piercing member as well as one or more seal assemblies between a gas cylinder and a piercing housing. The gas cylinder is used for holding compressed gases within a cavity defined by cylinder walls. The gas cylinder comprises a gas outlet at its top surface. The gas outlet is preferably equipped with a piercable diaphragm. The gas cylinder may be so formed that a neck is provided which includes a side surface and a top surface where the gas outlet is obtained.

[0008] The piercing housing is provided as a hollow recess sized for allowing the neck of a gas cylinder to be inserted into the housing through the opening of the housing and to be advanced against a piercing element as needed to open the gas outlet of the cylinder. The piercing housing is defined by side walls and a bottom wall which is vertical to the axis of the cylinder.

[0009] The piercing element can be connected with the bottom wall of the piercing housing in a variety of different ways such as being a section fixed on the bottom wall which protrudes into the housing, or being an actuation section which can move vertically to the bottom wall for piercing the outlet of the gas cylinder. The piercing element may be formed as a shaft with a piercing tip in which a channel is provided for leading the gas from the cylinder to further consumer after the piercing of the outlet of the gas cylinder.

[0010] At least one first seal assembly is formed to create a seal between the bottom wall of the piercing housing and the top surface of the gas cylinder. When the outlet of the gas cylinder is pierced by the piercing element and the gas cylinder is inserted into the piercing housing, the gas cylinder moves to a position where the top surface of the gas cylinder meets the bottom wall of the piercing housing, alternatively the movement can also be achieved by moving the piercing element toward the gas cylinder. The first seal assembly is therefore desired for resisting the loss of the gas as the gas cylinder is being opened. It prevents gas escape outwards.

[0011] At least one second seal assembly is provided to form a seal between the interior side walls of the piercing housing and the gas cylinder. This seal assembly helps when the outlet of the gas cylinder is pierced and the gas begins to release into the channel of the piercing element and the gas cylinder is not yet sealed by the first seal assembly. During this period which is after the piercing and before the sealing of the first seal assembly the second seal assembly is necessary for preventing the gas releasing via the gap between the side walls of the piercing housing and the gas cylinder and resisting the loss of the gas.

[0012] At least one bayonet mount with a male part and a female part is provided for connecting the gas cylinder with the piercing housing. This bayonet mount is necessary not only for moving the gas cylinder onto the piercing element with safe locking but especially for safe removing of the gas cylinder. When a user wishes to change the cylinder or removes the cylinder by mistake and if there is still high pressure gas remaining in the gas cylinder or in the piercing housing the bayonet mount can prevent the gas cylinder from being pushed backward strongly by the force which is caused by high pressure. The bayonet mount is so formed that during the removing of the gas cylinder, if there is no more pressure in the cylinder the male part can be twisted out from the female part without resisting so that the cylinder can be removed safely. But if there is still pressurized gas which provides a force pushing the cylinder the male part will be then locked by the female part. Without using considerable external forces the cylinder cannot be removed from the piercing housing as long as pressurized gas is in the piercing housing.

[0013] In the case when the male part of the bayonet mount is locked by the female part the second seal assembly is then especially necessary to prevent escape of gas. Since the top surface of the gas cylinder is not sealed any more by the first seal assembly and the piercing element might be completely or partly pulled out of the gas outlet or the piercable diaphragm by the axial movement of the cylinder, as a result, the remaining gas in the gas cylinder is released into the piercing housing. The pierced hole causes a high velocity of the gas flow which could cause loud noise, accidents and unwanted gas loss. By using the second seal the pressurized gas is prevented from escaping from the piercing housing outward via the gap so that the bayonet mount can be used successfully without gas escaping issues.

[0014] According to the present invention a gas cylinder is provided which has a preferred small size and designed to be easily portable and disposable e.g. having an overall length of about 6.5 cm to 7.5 cm and a diameter of about 1.5 cm - 2 cm The aspects of the invention may be also used with larger or smaller and/or differently shaped gas cylinder. The cylinder as used herein refers generically to a container which is arranged for storing and releasing gas under pressure. The cylinder has a neck preferably which includes a top surface, an outlet and a side surface. The outlet of the cylinder is preferably enclosed by a breakable surface which can be opened by a piercing element such as a sharpened or blunt lance. The neck of the gas cylinder has a diameter of about 0.5 cm and a length of about 1.5 cm to 2 cm but other sizes are also possible. The neck of the gas cylinder can be threaded, unthreaded or have any component for coupling with other members on which at least one bayonet mount can be arranged. The said members may be a collar-shaped element which is arranged on the neck of the gas cylinder. The pressurized gas in the gas cylinder may be oxygen, carbon dioxide, air, inert gas and mixtures thereof. Such a gas cylinder may be connected with a delivering system which supplies the pressurized gas to a user such as supplying inert gas into a bottle containing liquid for better storage, supplying carbon dioxide into beverage for carbonization or, preferably, introducing oxygen into wine. Pressure ranges for such cylinders can range from around 100 bar to 200 bar and for the most commercial gas cylinder with the aforementioned size and shape the pressure ranges from around 160 to 190

[0015] In one embodiment of the invention the gas cylinder may be held by a container which has a screwing opening and a chamber defined inside of the container. The chamber is cylinder-shaped and adapted to retain the gas cylinder. The screwing opening is defined in a top of the container and corresponds a screwing portion which may be provided on the exterior of the piercing housing for locking the container with the piercing housing together, so that the gas cylinder retained in the container can be fixed in the inner space which is defined by the piercing housing and the container. The container may have any size as long as needed for holding the gas cylinder. Especially the container is sized portable as the gas cylinder which can be held easily by hands.

[0016] In a preferred embodiment the male part of the said bayonet mount may be formed by arranging one or more pins radial to the cylinder axis on the interior sidewall of the piercing housing. The female part is formed by one or more particular shaped grooves on the neck of the cylinder which comprise four grooves sections. The first groove section is a longitudinal groove which is parallel to the cylinder axis and has an entrance on the top surface of the gas cylinder to allow the pin to slide into the groove. The second groove section is vertical to the first groove section which has a first end combining the first groove section, a second end combining both the third groove section and the fourth groove section which is called connecting point in the further description. The third groove section and the fourth groove section are formed both vertical to the second groove section and connected together at the connecting point. The third groove section and the fourth groove section are combined in one line which is parallel to the first groove section. The fourth groove section extends downwardly in direction of insertion of the gas cylinder and the third groove section extends upwardly in the opposite direction of the fourth groove section. Combining means here that the grooves are connected in a way so that the pins can slide from the first groove section to the third groove section or fourth groove section.

[0017] The pin slides into the first groove section via the entrance, rotates across into the second groove section and then pushed forward along the second groove section. Once the pin reaches the connecting point, the gas cylinder is moved axially towards the piercing element till the outlet of the gas cylinder is pierced by the piercing element while the pin is sliding along the fourth groove section and located at the end of the fourth groove

section. This particular arranged bayonet mount helps not only locking the gas cylinder and the piercing housing together but especially for a safe removing of the gas cylinder. During removal of the gas cylinder the pin is pushed along the fourth groove section back to connecting point. If there is still pressure remaining in the gas cylinder or in the piercing housing, the pin will not stop at the connecting point for further rotation across into the second groove section, but will be pushed by the remaining pressure into the third groove section. As a result, the gas cylinder can not be twisted out and will be locked in the third groove section as long as the high pressure remains. It should be understood that the particular groove is not restricted only to this shape, any shape of the groove, which has the same principle and which can lock the gas cylinder in position when still pressurized gas remains during disconnecting, is possible.

[0018] The male part and the female part of the bayonet mount can be also arranged reversely, which means that the one or more pins are arranged on the neck of the gas cylinder and the one or more particular grooves are arranged on the interior side wall of the piercing housing.

[0019] In another embodiment of the invention a collar-shaped element may be provided on the neck of the gas cylinder. The collar-shaped element is formed as an annular side wall engaged with the neck of the cylinder with a variety of connecting means such as threaded, unthreaded, gluing, shrinking fitting and so on. The said bayonet mounted is arranged preferably on the collar and further one or more seal assemblies may be also arranged on the collar. The collar may be connected with the gas cylinder in a permanent way. The gas cylinder connected with the collar having bayonet mount and sealing such as an O-ring may be single used for replacement.

[0020] It is preferred to arrange a spring to keep the two parts of the bayonet mount locked together. In using of the spring the pin at the connecting point can be pushed by the spring into the third groove and keep locked into place. The pins will be pushed back against the spring when the cylinder is piercing onto the piercing element. The spring might be arranged on the collar and might be also located in the piercing housing.

[0021] The second seal assembly is designed preferable as an O-ring seated in a groove on the neck of the cylinder, especially in a groove of the collar which is connected with the neck of the cylinder. This is very advantageous in compare with the seal assembly arranged on the piercing housing, because a new sealing may be provided each time a new cylinder is installed so that any chance of wear due to repeated use can be reduced. The O-ring seal assembly is necessary during the axial movement between the piercing housing and the gas cylinder. The sealing is performed by deformation of the O-ring by engagement with the piercing housing. In addition, other seal assemblies are also possible.

[0022] The first seal assembly is designed preferable as a High Pressure Seal (HP Seal) on the bottom wall of the piercing housing or at the top surface of the gas cylinder. The first seal assembly is used to form a proper seal which can be subjected under high pressure between the bottom wall and the top surface of the gas cylinder. The pierced hole represents an opening which must be sealed to guarantee that pressures are kept inside and thereby avoid leaking which might cause accidents, gas losses, among other negative factors. Other seal assemblies can be also possible as like a face seal formed by a soft polymer face to outlet of the gas cylinder.

[0023] The piercing housing may include one or more venting openings in the side wall of the piercing housing. The openings can be designed as one or more vent holes which allow venting the high pressure gas when the first seal assembly fails or especially in the case when the gas cylinder is removed from the piercing element and locked by the bayonet mount due to the high pressure remained in the gas cylinder. The high pressure gas is not able to release via the gap between the gas cylinder and the piercing housing because of the second seal assembly. Thus the gas releases via the opening in the piercing housing to the atmosphere until the pressure in the piercing housing equals to the atmosphere pressure, so that a safe removal of the gas cylinder can be achieved. In addition the opening can be also designed as porous material such like polymer- or foam material or designed as a sintered ring, which slows the flow and reduces the venting noise. Further, a venting opening designed of porous material prevents dust going into the piercing housing which might cause malfunction of the actuation section in the piercing housing. The openings can be formed with any shape and any size as long as the gas can be released thereby.

[0024] The openings are arranged preferably in the side wall of piercing housing at the position where is closest to the piercing element, so in use, when the gas cylinder is pushed to the bottom of the piercing housing, the opening is closest to the pierced outlet of the cylinder which may help venting the pressure gas in a fast and efficient way.

[0025] Preferably, the pressurized gas in the gas cylinder is delivered into a liquid in which the pressurized gas is needed for different purposes such as oxidation, carbonization, inertization etc. The liquid is preferably a wine and the compressed gas is preferably oxygen.

[0026] The pressurized gas may contain more than 20% vol. oxygen when measured at atmospheric pressure. It contains preferably more than 50% oxygen, more preferred more than 80% vol., particular preferred more than 90% vol. more particular preferred more than 99% vol. The pressurized gas may be also technical pure oxygen.

[0027] It will be appreciated that any form of pressurized gas source may be used. Indeed, the gas cylinder described above may be single use with the preferred features described above and it can be also replaceable or refillable.

[0028] The present invention will now be described

with reference to the following non-limiting examples and the accompanying schematic figures in which:

Figure 1 shows a section view of assembly device for oxygenating wine,
Figure 2 shows a view of the bayonet mount and
Figure 3 shows a perspective view of the sealing assembly.

[0029] Figure 1 shows a portion of a hand-held device for introducing oxygen into a bottle of wine. The device shown in the figure 1 is formed of three main parts: a gas cylinder 1, a piercing housing 7 and a piercing element 4. The gas cylinder 1 is filled with pressurized gas such as oxygen or carbon dioxide enclosed by a piercable diaphragm 3. The gas cylinder is designed to be easily portable and disposable and has an overall length of about 6.5 to 7.5 and a diameter of about 1.5 to 2 In this embodiment, the gas cylinder has a neck 2 which has a smaller diameter of about 0,5 to 1 than the main body of the gas cylinder. The neck 2 is defined by a side wall and a top surface on which the piercable diaphragm 3 is arranged. This piercable diaphragm 3 is the outlet of the pressurized gas. A full filled gas cylinder with this size has a pressure between 150 bar and 200 bar

[0030] The piercing housing is defined by a side wall 8 and a bottom wall 9 which is sized to allow the neck 7 of the gas cylinder to be inserted into completely. On the bottom wall 9 of the piercing housing, a High Pressure (HP) seal 6 is formed as an annular sealing ring surrounding the piercing element 4 which is arranged for preventing the pressurized gas escaping from the gas cylinder 1 via the pierced outlet 3 to the piercing housing 7 when the gas cylinder 1 is pushed forward onto the piercing element 4 and engaged with the bottom wall 9. It has not to be limited only to the HP seal, other sealing forms are also possible. On the side wall 8 of the piercing housing, one or more pins 11 a are arranged as the male part of a bayonet mount which is used for locking the gas cylinder 1 at a certain position in the piercing housing 7.

[0031] A female part 11 b of the bayonet mount comprises one or more particular grooves and it is arranged on the neck 2 of the gas cylinder via a collar 12 which is formed as a cylindrical sidewall for receiving the neck 2 of the cylinder. In this embodiment an O-ring 10 is arranged on the collar 12 by seating in a groove formed on the collar 12 and a spring 13 is also arranged in a groove where is formed on the edge of the bottom wall of the piercing housing as shown which provides a force against the direction of insertion to keep the pins 11 a locked into place. The collar 12 having an O-ring and bayonet mount is connected with the gas cylinder 1 in a permanent way so that the gas cylinder 1 can be used or replaced in a simple way with the above mentioned special features on the collar 12 which can be new provided every time a new gas cylinder is produced.

[0032] The piercing element 4 is formed as a blunt ended or truncated cone which allows the pierce diaphragm to be deformed quite considerably before rupturing it. The piercing element 4 is provided with a channel 5 in the cone which allows the pressurized gas to escape from the gas cylinder 1 and via the channel 5 into further delivering or dispensing assemblies e.g. valve, membrane.

[0033] The gas cylinder 1 is held by a container 14 defined by a cylindrical wall and an opening for retaining the cylinder 1. The container 14 has a screwing part 16 at the opening which correspond a screwing portion provided on the exterior of the piercing housing 15 for fixing the gas cylinder 1.

[0034] A series of vent holes 17 is provided in the piercing housing 7. The venting holes 17 help when a user attempts to remove the still pressurized cylinder. The gas velocity will then be controlled by passing through the venting holes 17 which slow down the flow and reduce the venting noise. The venting holes 17 may be formed as a sintered ring which is located in the side wall 8 of the piercing housing where is closest to the piercing element 4.

[0035] In the figure 2 the female part 11 b of the bayonet mount on the collar 12 is shown. The female part 11 b is formed by one or more particular shaped grooves which contain four grooves sections A, B, C, D. The A part groove is a longitudinal groove which is parallel to the cylinder axis and has an entrance on the top surface of the gas cylinder 1 so that the pin 11a can slide into the groove. The B groove is vertical the A groove which has a first end combining the first part groove and a second end E combining the further two grooves. The C groove and the D groove are formed both vertical to the B groove and connected with each other at E. The C groove and E grove are in one line which is parallel to the A groove. The C groove extends upwardly in direction of insertion of the gas cylinder and the D groove extends downwardly in the opposite direction of the C groove as shown. The pins 11 a slide into the A groove via the entrance, rotate across the B groove and is then pushed forward along the B groove to reach E. In so doing a spring is acted upon to give some bias that the pins slide into C groove which the pins normally locates. When the container 14 is screwed down onto the cylinder 1 it urges the cylinder 1 forward onto the piercing member 4 which brings the pins 11 a into D groove and the gas can be released from the cylinder 1. The C groove is provided also as an additional safety feature. The pins 11 a will slide into C groove when the cylinder to be removed is still pressurized. This will then prevent the possibility of a "fly off "cylinder if the container is accidently unscrewed by a user.

[0036] The O-ring 10 in the figure 2 is arranged below the bayonet mount 11 b. In use, the O-ring 10 is deformed by the side wall 8 of the piercing housing which creates a sealing between the neck 2 and the piercing housing 7. It should be known, that the sealing is not limited to this form, other sealing assemblies are also possible as like face sealing

[0037] In figure 2 the gas cylinder 1 is connected with

the collar 12 on which an O-ring 10 and a bayonet mount 11 b are arranged. This configuration is particular advantageous while a simple replacement of the cylinder and a safe releasing of pressurized gas is possible.

[0038] The figure 3 shows a perspective view of the gas cylinder as well as the sealing and connecting device. The gas cylinder 1 or the neck 2 of the cylinder fixed with the collar 12 is inserted into the piercing housing 7 and the bayonet mount 11 b is then locked with the piercing housing 7. During the insertion the O-ring 10 is creating a sealing between the neck 2 and the side wall of the piercing housing 7 which is especially important when the piercable diaphragm is pierced already by the piercing element but has not been sealed by the HP sealing yet. The gas which might leak from the cylinder will thereby be locked in the piercing housing and via the venting holes 17 flow outward in a controlled manner. The pins slide from A groove to D groove against the force of the spring 13 and then located at the end of the D groove by threading the container 14 onto the piercing housing 7 for fixing.

[0039] After the piercing if someone unintentionally unscrewed the container 14 whilst there was still pressure within the cylinder 1, the cylinder 1 would only be pushed back by the pressure but only allowed to move back to the end of the C groove and the cylinder 1 is thus held in position while the gas contents can vent off via the venting holes 17 and not act to make the cylinder 1 a projectile. To remove the cylinder 1 when empty a force is applied to push it in against spring 13 bias and twist it out. The O-ring 10 limits the gas escape path and keeps it only in the piercing housing 7 but not escape into the container 14 or outside. This therefore allows the container 14 to be made of a non pressure bearing material such as an injection moulded polymer rather than a machined metal part and directs the pressure away from the hand held piece.

[0040] This whole setup in figure 3 can be connected with further delivering mechanism such as a tube, a controlling valve or/and with dispensing mechanism such as membrane, fiber. A concrete example for using this setup can be a wine oxygenation device which is used for improving its taste. In this wine oxygenation device the gas cylinder connected with this sealing device is combined with a gas diffusing membrane which allows a relatively high flow rate of oxygen gas to be diffused into the wine in a controlled manner.

Claims

1. A sealing device comprising,

- a piercing housing for holding a gas cylinder with a top surface comprising a gas outlet
- the piercing housing comprising side walls and a bottom wall which is vertical to the axis of the cylinder
- a piercing member arranged in the piercing housing for piercing the gas outlet of the cylinder and at least one first seal assembly to form a seal between the bottom wall of the piercing housing and the top surface of the cylinder and at least one second seal assembly to form a seal between the side walls of the piercing housing and the cylinder

characterized in that at least one bayonet mount with a male part and a female part is provided for connecting the cylinder with the piercing housing.

2. The device according to claim 1, **characterized in that** a gas cylinder is provided and it contains more than 21 vol% oxygen, particular more than 80 vol% oxygen, more particular more than 99 vol% oxygen.

3. The device according to any preceding claim, **characterized in that** a container is used for holding the gas cylinder.

4. The device according to any preceding claim, **characterized in that** the male part is formed by arranging one or more pins radial to the cylinder axis in the piercing housing and the female part is formed by arranging at least one particular shaped groove wherein the said groove comprising four grooves sections wherein the first groove section (A) is formed parallel to the cylinder axis, wherein the second groove section (B) is formed vertical to the first groove section (A) and with a first end connected the first groove section (A) and a second end connected with both the third groove section (C) and the fourth groove section (D), wherein the third (C) and fourth groove sections (D) are formed both vertical to the second part groove (B) and connected together at the second end of the second groove section (B) in one linear which is also parallel to the first groove section (A).

5. The device according to any preceding claim, **characterized in that** the female part being part of or connected to the cylinder

6. The device according to claim any preceding claim, **characterized in that** a collar is arranged on the neck of the cylinder

7. The device according to any preceding claim, **characterized in that** a spring is arranged in the piercing housing.

8. The device according to any preceding claim, **characterized in that** a screw assembly is disposed between the container and the pierce housing to hold the cylinder and the piercing housing together.

9. The device according to any preceding claim, **characterized in that** the second seal assembly is designed as an O-ring seated in a groove of the collar on the neck of the cylinder.

10. The device according to any preceding claim, **characterized in that** the first seal assembly is a High Pressure (HP) Seal.

11. The device according to any preceding claim, **characterized in that** the second seal assembly is designed as a face seal by molding a soft polymer face to the cylinder neck.

12. The device according to any preceding claim, **characterized in that** the piercing housing contains at least one venting opening

13. The device according to claim 12, **characterized in that** the venting openings are arranged in the side walls of the piercing housing and at the position which is closest to the piercing element.

14. The device according to claim 12 or 13, **characterized in that** the venting opening is formed with porous material.

15. A gas cylinder with a male part or a female part of a bayonet mounts.

Fig.1

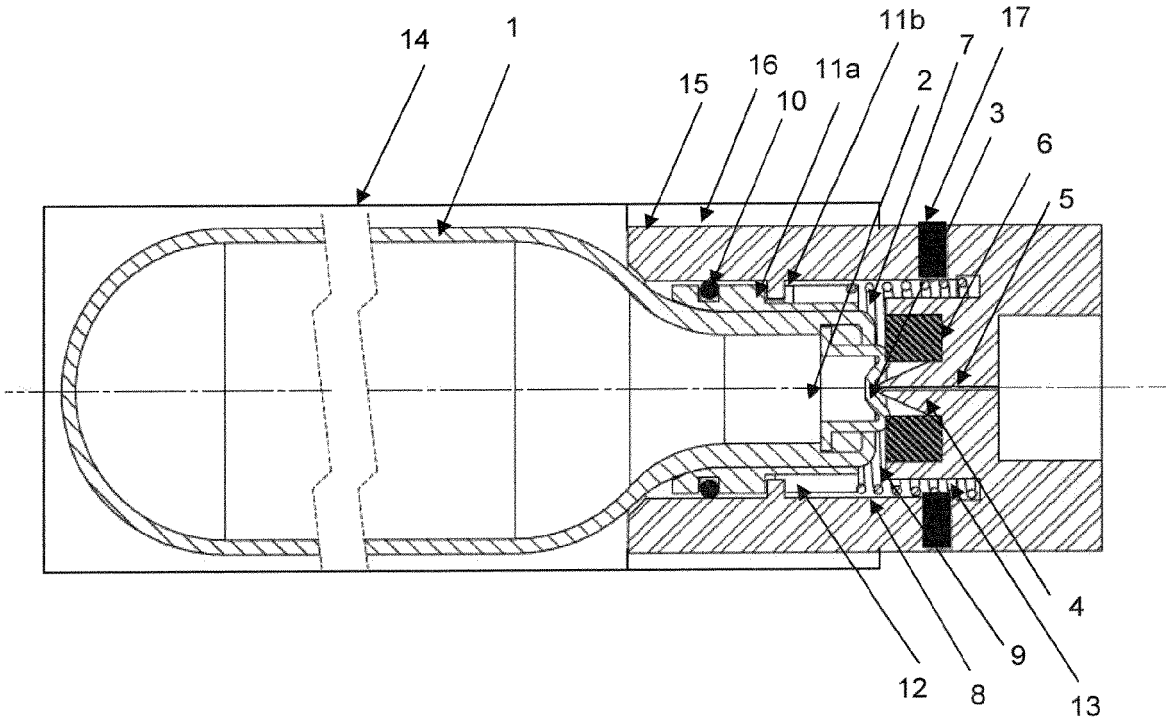


Fig.2

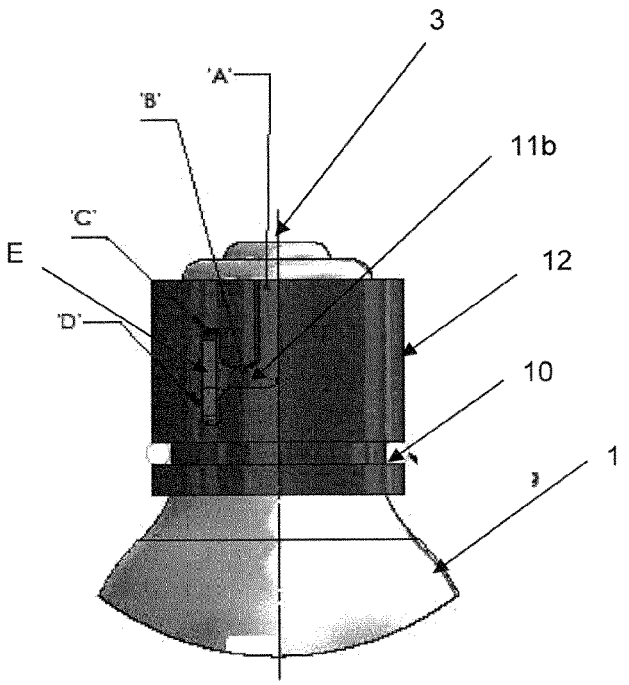
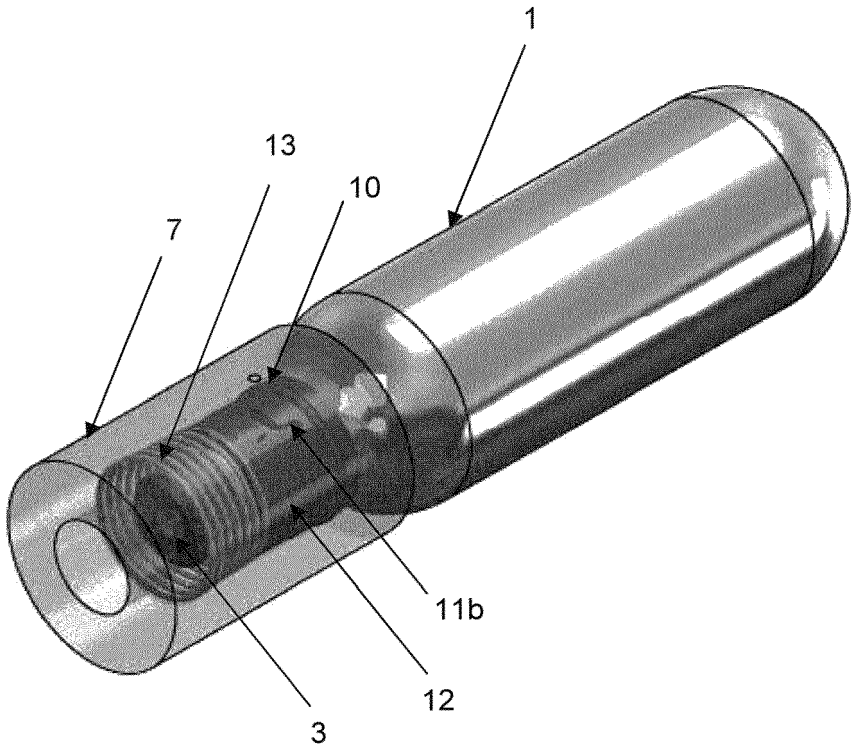


Fig.3



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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 4382

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2004/107951 A1 (D ARCY KENNETH R [US] ET AL) 10 June 2004 (2004-06-10) * fig.3, pos.30, pos.34, pos.35, pos.36, pos.20, pos.68, pos.76, pos.80; fig.4, pos.20; paragraph [0050] - paragraph [0050]; claims 1,4,5,6,9 * * fig.2, fig.5, fig.6, pos.1; claim 3 * * fig.3, pos.63; claims 12,13 * * fig.3, pos.34, pos.62; paragraph [0050] - paragraph [0050]; claim 15 * -----	1,2,4-6, 9,11-15	INV. F17C1/00
X	US 2 890 815 A (FELICIEN CORLET GABRIEL) 16 June 1959 (1959-06-16) * fig.1; fig.3, pos.13a; fig.1, pos.7, pos.8a, pos.10; fig.6, pos.1a, pos.1b, pos.7; fig.2, pos.1a, pos.1b; Col.1, l.58-66; claims 1,4,10 * * fig.2, pos.1; fig.5, pos.1; fig.6, pos.1; claim 3 * * fig.1, pos.9; claim 7 * * fig.2, fig.5, fig.6, pos.2; claim 8 * -----	1,3,4,7, 8,10	TECHNICAL FIELDS SEARCHED (IPC) F17C
A	WO 2014/037425 A1 (LINDE AG [DE]) 13 March 2014 (2014-03-13) * fig.1, pos.4, pos.6, pos.10; fig.3, pos.16, pos.32, pos.30, pos.24; claims 1-15 * -----	1-15	
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 June 2015	Todor, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 4382

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	FR 2 216 514 A1 (NIPPON PISTON RING CO LTD [JP]) 30 August 1974 (1974-08-30) * fig.1, fig.2; claims 1-15 *	1-15	
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Place of search	Date of completion of the search	Examiner
Munich	26 June 2015	Todor, H

CATEGORY OF CITED DOCUMENTS

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