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(54) A MULTIPLE SEAL GAS CYLINDER

(57) A connecting arrangement for a gas cylinder having a neck with a side surface and a top surface including a gas outlet comprises,

- a piercing housing for receiving the neck of the gas cylinder comprising an opening, a side wall and a bottom wall
- a piercing member arranged in the piercing housing for piercing the gas outlet
- a collar arranged on the neck of the gas cylinder having a side surface which extends above the top surface of the gas cylinder and defines an inner space
- a primary seal element arranged in the inner space forming a seal with the top surface of the gas cylinder
- wherein the primary seal element is so arranged that a

spacing is formed between the collar and the primary seal element

wherein in that a seal support element is arranged in the piercing housing which defines a chamber having an opening in the direction of the opening of the piercing housing such that the primary seal element fills the chamber when the piercing member is received in the collar to pierce the gas outlet and a radial expansion of the primary seal element in response to forming a seal with the piercing member is restrained in this chamber by the seal support element, wherein the primary seal element and the collar are unattached to the piercing member and the seal support element.

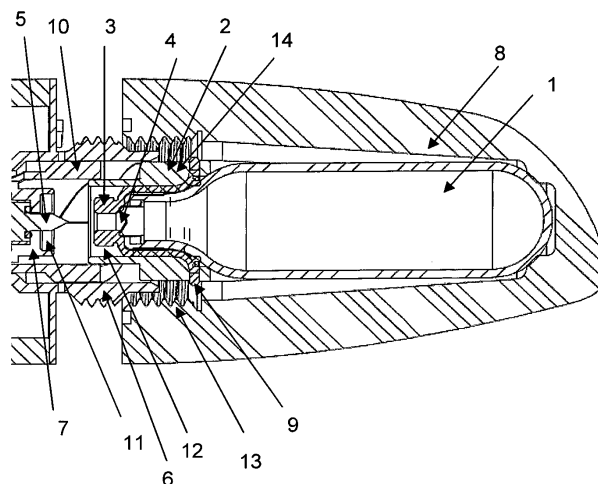


Fig. 1

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Description

[0001] The present invention relates to a connecting arrangement for a gas cylinder having a neck with a side surface and a top surface including a gas outlet comprising:

- a piercing housing for receiving the neck of a gas cylinder comprising an opening, a side wall and a bottom wall
- a piercing member arranged in the piercing housing for piercing the gas outlet
- a collar arranged on the neck of the gas cylinder having a side surface which extends above the top surface of the gas cylinder and defines an inner space
- a primary seal element arranged in the inner space forming a seal with the top surface of the gas cylinder and provides an opening to receive the piercing member to pierce the outlet of the gas cylinder,
- wherein the seal assembly is so arranged that a spacing is formed between the collar and the primary seal assembly

[0002] A connecting arrangement is well known to connect the gas cylinder with the said piercing housing having a piercing member therein which is commonly combined with further assemblies in use like tube, valve etc. 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 gas cylinder by attaching the piercing member to the gas cylinder which causes the diaphragm to be pierced and the gases to be released from the gas cylinder through the piercing member to further assemblies. A dense connecting arrangement is therefor desirable in order to prevent escaping of the compressed gas.

[0003] It is well known that a gas cylinder filled with gas can be used to treat beverage or alcohol with the aim of carbonating, aerating or inertization. Compressed gas cylinders can be filled with different types of gas such as carbon dioxide, oxygen, helium, nitrogen and other gases. Nowadays more and more devices have been developed which requires such gas cylinders in small size which is portable and could be used at home or on the way. These commercially available compressed gas cylinders for storing gases are necessarily high pressured and relatively low volume, and thus any loss of the gas in the process of connecting the gas cylinder to the piercing housing or delivery mechanism or after such connection, is undesirable. Therefore, effective sealing is necessary to be provided which prevents the undesirable escape of the compressed gas from the gas cylinder as the gas cylinder is being opened or during the delivery mechanism for a long period of time.

[0004] In the prior art it is commonly that a collar is installed on the neck of the gas cylinder which extends

axially above the top surface of the gas cylinder and defines an inner room and an upward opening for receiving the piercing member. In order to form a seal between the gas outlet and the piercing member a seal element is arranged in this inner room defined by the collar. This seal element touches the top surface of the gas cylinder and exposes to the opening of the collar. So during the piercing member is being pushed towards the gas outlet and piercing it the seal element can form a proper seal to make sure that the gas does not leakage under compression.

[0005] As the leakage of compressed gas could cause unexpected accident and injury especially when the gas cylinder is portable and the user hold it by hand. It is therefore desirable that the seal element is able to withstand high compressive loads and simultaneously has a reliable performance.

[0006] The task of the present invention is to provide a connecting arrangement for a gas cylinder with a tight and effective seal under compression so that a safe and reliable usage of the gas cylinder connecting with corresponding device can be achieved.

[0007] This task is accomplished by the features in claim 1. The advantageous embodiments are described in the dependent claims.

[0008] 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 enclosed with a pierceable diaphragm. The gas cylinder is so formed that a neck is provided which includes a side surface and a top surface where the gas outlet is obtained.

[0009] The 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 6.0 cm to 7.0 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 gas cylinder as used herein refers generically to a container which is arranged for storing and releasing gas under pressure. The gas cylinder has a neck which includes a top surface, an outlet and a side surface. The outlet of the gas cylinder is preferably enclosed by a breakable surface which can be opened by a piercing member such as a sharpened or blunt lance. The neck of the gas cylinder has a diameter of about 0.5 cm to 1 cm and a length of about 0.5 cm to 2 cm but other sizes are also possible. 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 preservation, supplying carbon dioxide into beverage for carbonization or, preferably, introducing oxygen into wine. Pressure ranges for such cylinders can range from around 100 bars to 200 bar and for the most commercial gas cylinder with the aforementioned size and shape the pressure ranges from around 150 bars to 200 bars.

[0010] The piercing housing for receiving the neck of the gas cylinder comprising an opening, a side wall and a bottom wall is provided. This piercing housing is sized for allowing the neck of a gas cylinder to be inserted into the piercing housing through the opening of the piercing housing and advance against a piercing member to open the gas outlet of the gas cylinder. The piercing housing is defined by side wall and a bottom wall which is vertical to the axis of the gas cylinder when the gas cylinder is being pushed into the piercing housing. The bottom wall is a plane on which the piercing member is arranged.

[0011] The piercing member may be formed as a shaft with a piercing tip in which a channel is provided for leading the gas from the gas cylinder to further mechanism after the piercing of the outlet of the gas cylinder such as a valve or control means.

[0012] A collar is arranged on the neck of the gas cylinder having a side surface which extends above the top surface of the gas cylinder and defines an inner space. The collar has a lower portion and an upper portion. The lower portion is engaged with the neck of the gas cylinder with a variety of connecting means such as threaded, unthreaded, gluing, and shrinking fitting, friction fitting and so on. The upper portion extends axially above the top surface of the gas cylinder and defines an inner space with an upward opening. This inner space and the opening define a channel for receiving the piercing member. The collar can also protect the gas outlet in transport and in handling.

[0013] A primary seal element is arranged in the inner space forming a seal with the top surface of the gas cylinder, wherein it is so arranged that spacing is formed between the collar and the primary seal element. The spacing is preferred ring-shaped defined by the primary seal element and the upper portion of the collar.

[0014] The primary seal element is designed preferably as a High Pressure Seal, sealing up to 200bar. The primary seal element is able to deform and used to form a proper seal which can be subjected under high pressure between the piercing member and the top surface of the gas cylinder. The material of the primary seal element comprises preferably a polyurethane, silicone or rubber. Other materials also qualify depending on the used gas and pressure. As a result, when the gas cylinder is being pushed into the piercing housing, the piercing member goes via the channel to press the primary seal element to pierce the gas outlet of the gas cylinder. An axial seal is formed between the piercing element and the top surface of the gas cylinder by the primary seal element. A radial seal for the piercing member is formed subsequently by a radial expansion of the primary seal element which is caused by the axial compression of the primary seal element to maximize the sealing performance.

[0015] According to the present invention a seal support element is arranged in the piercing housing which defines a chamber between the piercing member and the seal support element having an opening in the direction of the opening of the piercing housing such that the

primary seal element is kept within the chamber when the piercing member pierces the gas outlet and a radial expansion of the primary seal element in response to forming a seal with the piercing member is restrained in this chamber by the seal support element, wherein the primary seal element and the collar are unattached to the piercing member and the seal support element.

[0016] The seal support element defines the chamber and it is so shaped to be fitted into the spacing between the primary seal element and the collar especially the upper portion of the collar when the piercing member pierces the gas outlet. As a result, after piercing the primary seal element is enclosed within the chamber which is surrounded by the upper portion of the collar. The radial expansion of the primary seal element is caused by compressing the gas cylinder and the piercing member together which can maximize the radial sealing performance for the piercing member. The restraint of the radial expansion of the primary seal element by the seal support element makes the primary seal element fill the chamber more tightly which enhances the seal performance for the piercing member advantageously. Preferably, this radial expansion of the primary seal element is restrained only by the seal support element and the piercing member. In addition, since the seal support element is covered by the upper portion of the collar during the piercing process as like a double resistance to prevent the leakage of the compressed gas, an extremely tight seal is thereby formed. It is also advantageous to have this seal support element in the piercing housing that only a gas cylinder with appropriate counterpart which means with a corresponding collar and a corresponding primary seal element can be connected with this piercing housing. So a utilization of an incorrect gas cylinder can be avoided. In addition, the collar can protect the primary seal element in transport and in handling. The seal support element contacts preferably the piercing member with a seal between the contact surfaces.

[0017] The seal support element is attached to the piercing housing and the piercing member and is unattached to the gas cylinder and the primary seal element. The primary seal element is attached to the gas cylinder and unattached to the piercing housing and the piercing member, so a new primary seal element may be provided each time a new gas cylinder is installed, thus eliminating any chance of wear due to the repeated use.

[0018] The seal support element comprises preferably a circular wall which surrounds the piercing member and extends axially from the bottom wall of the piercing housing in direction of the opening of the piercing housing, wherein the axial direction is the direction of the axis of the gas cylinder when the gas cylinder is being pushed into the piercing housing. This circular wall defines the chamber for accommodating the primary seal element. The piercing member is located in the center of the chamber. When the gas cylinder is being pushed onto the piercing member, the primary seal element fills the chamber having the piercing member in the center and forms

an axial and a radial seal with the piercing member. Its radial expansion is limited inside this chamber by the circular wall and the piercing member. The circular wall is preferred so tall that the radial expansion of the primary seal element is restrained only by the circular wall and the piercing member in the center.

[0019] Preferably, a space is provided between the seal support element and the side wall of the piercing housing where other elements for connecting with the gas cylinder having the collar can be arranged. The space is preferred ring-shaped and the width of this ring is preferred broader than the width of the upper portion of the collar on the gas cylinder, so the gas cylinder having the collar can be pushed into the piercing housing.

[0020] The seal support element and the primary seal element are so arranged in the piercing housing and on the gas cylinder respectively that the seal support element is able to be inserted into the spacing between the primary seal element and the upper portion of collar and the upper portion of the collar is able to be inserted into the space between the side wall of the piercing housing and the seal support element. So the sealing performance of the piercing member is much enhanced by the between each other inserted wall and by the multiple covered primary seal element.

[0021] The space between the seal support element and the side wall of the piercing housing is preferred so large that other connecting elements can be arranged inside. These connecting elements can be a male element or a female element which has a corresponding counterpart arranged on the collar so during the piercing process the gas cylinder with the collar having multiple connecting elements as like the female element, the upper portion as well as the primary seal element can be connected with the piercing member and the piercing housing in a reliable and tight way.

[0022] Preferably, the said male element and its corresponding female element are so formed respectively in the piercing housing and on the collar that after engaging of the male and female elements a relative rotation between the gas cylinder and the piercing member is prevented. The male and the female element are preferred one an axially along the collar extended section and another one an axially along the side wall of the piercing housing extended section respectively, wherein one section has one or more recesses which corresponds the shape of the other section to be capable of engaging together. The profile of the said sections has preferably no straight lines at the direction which is vertical to the said axis so that the female portion can orientate itself to the correct position by pushing axially to fit it into the male portion.

[0023] Preferable, the male element in the piercing housing can be pushed axially backwardly relative to the piercing member by the female element on the collar. This male element may contact with one or several springs. During the axial movement of the gas cylinder the spring enables the male element to move backward

to allow the gas cylinder to approach the piercing member for piercing the gas outlet. When the gas cylinder is being removed from the piercing member the male element supports its movement by the compressed spring to eject the gas cylinder from the piercing member. This actuation of the male element has the advantage that the piercing member will only pierce the correct gas cylinder which is designed to be able to access into the piercing housing and push the male element to meet the piercing member.

[0024] Preferably, the said female element on the collar has at least two recesses which sit opposite each other and have preferable a same shape which could be a curve, a parabola, a part of triangle, symmetrically or unsymmetrically.

[0025] A container is provided to receive the gas cylinder and comprises a connecting means to connect with the piercing housing. The container is cylinder-shaped and adapted to receive the gas cylinder. The connecting means could be a thread which is arranged at the opening of the container. A corresponding thread portion may be provided on the exterior side wall of the side wall of the piercing housing for meshing 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 gas cylinder can advance onto the piercing member by threading the container onto the piercing housing which converts a radially movement to an axially movement. The container may have any size as long as needed for receiving the gas cylinder. Especially, the container is sized portable as the gas cylinder which can be held easily by hands.

[0026] The collar comprises preferably a secondary seal element on the side surface of the collar which is arranged to form a seal between the side wall of the piercing housing and the collar. This secondary seal element helps when the outlet of the gas cylinder is pierced and the gas begins to release into the channel of the piercing member and the gas cylinder is not yet sealed tightly by the primary seal element. During this period the secondary seal element is especially 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.

[0027] The second seal assembly is designed preferable as an O-ring seated in a groove on 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 element 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.

[0028] 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 preferred a wine and the compressed gas is preferred oxygen.

[0029] A gas cylinder having a collar on which multiple seal elements are arranged as previously described is provided. The multiple seal element includes the male or female element, the secondary seal element, the upper portion which can be inserted into the space between the seal support element and the piercing housing, the primary seal element which is arranged in the inner space defined by the upper portion.

[0030] The pressurized gas may contain more than 21 % 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.

[0031] It will be appreciated that any form of pressurized gas source may be used. Indeed, the gas cylinder engaged with a collar which is described may be single use with the preferred features and it can be also replaceable or refillable.

[0032] 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 the connecting arrangement for a gas cylinder received in a container for oxygenating wine

Figure 2 shows a section view of the gas cylinder connected with the piercing housing.

Figure 3 shows an exterior view of the gas cylinder with the collar

Figure 4 shows a section view of the gas cylinder with the collar from the A-A view of the figure 3.

Figure 5 shows an exterior view of the gas cylinder with the collar

[0033] Figure 1 shows a section view of the connecting arrangement between the gas cylinder 1 and the piercing housing in an unconnected status. The gas cylinder 1 has a neck shaped by a side surface and a top surface including a gas outlet 4.

The gas cylinder 1 is filled with pressurized oxygen enclosed by a pierceable diaphragm which can be seen as a gas outlet 4. The gas cylinder 1 is designed to be easily portable and disposable and has an overall length of about 6.5 cm to 7.5 cm and a diameter of about 1.5 cm to 2 cm. In this embodiment, the gas cylinder has a neck which has a smaller diameter of about 0.5 cm to 1 cm than the main body of the gas cylinder 1. A full filled gas cylinder with this size has a pressure between 100 bars and 200 bars.

[0034] The gas cylinder 1 is held by a container 8. The container 8 has a thread 13 at the opening which correspond a thread on the side wall 6 of the piercing housing. The container 8 provides an axially force to the gas cylinder 1 by threading it onto the piercing housing.

[0035] A collar 2 having an upper portion and a lower portion is provided. The lower portion is engaged with the neck of the gas cylinder with connecting means as threaded, gluing, shrinking fitting, friction fitting and so on. The upper portion extends axially above the top surface of the gas cylinder 1 and defines an inner space. In the inner space 12 a primary seal element 3 is arranged. The primary seal element 3 surrounds the gas outlet 4 providing a channel for the piercing member 5 and forms a seal with the top surface of the gas cylinder 1. As shown the primary seal element 3 is so shaped in the inner space that a spacing 12 is formed between the primary seal element 3 and the upper portion of the collar 2.

[0036] A secondary seal element 9 is arranged on the collar 2, preferably on the lower portion of the collar 2. The secondary seal element 9 is preferably formed as an O-ring sitting in a groove of the collar 2 to form a seal between the collar 2 and the side wall 6 of the piercing housing. Other seal assemblies are also possible.

[0037] The piercing housing serves as an adapter comprising different corresponding counterparts which can connect to the gas cylinder 2 appropriately. The piercing housing is defined by an opening, a side wall 6 and a bottom wall. In this embodiment the bottom wall is a plane which is vertical to the axial of the gas cylinder 1 and on which a piercing member 5 is situated. The bottom wall could be any part of further dispensing assemblies e.g. valve, membrane. The piercing member 5 is preferably situated in the center of the piercing housing. The piercing member 5 is formed as a blunt ended or truncated cone which allows the gas outlet 4 to be deformed quite considerably before rupturing it.

[0038] The gas outlet 4 and/or the piercing member 5 are preferably made of a metallic material, for example steel or stainless steel. The piercing member 5 is provided with a channel in the cone which allows the pressurized gas to escape from the gas cylinder 1 and via the channel into further dispensing assemblies. Such a piercing of the outlet by means of a blunt end avoids particulate being separated from the outlet during piercing.

[0039] A seal support element 7 is arranged surrounding the piercing member 5 which comprises a circular wall defining a chamber 11. The chamber 11 has an opening for receiving the primary seal element 3. The cross-section of the chamber 11 has preferably a round like shape whose area is smaller than the piercing housing. The seal support element 7 is so arranged in the piercing housing that a space is thereby provided between the seal support element 7 and the side wall 6 of the piercing housing. In this space a male element 10 is arranged. The corresponding female portion 14 is arranged on the collar 2. The male element 10 is preferable able to be pushed axially in the direction of the bottom wall by the female element 14. The male element 10 is formed as a circular wall which has recesses so after engaging the female element 14 on the collar 2 the gas cylinder 1 and the piercing member 5 cannot be rotated relatively. Advantageously, it can avoid the undesirable

friction force or transverse force caused by the rotation. This rotary movement can lead to damage of the seal elements as well as the piercing member which results to leakage or related accident or loss.

[0040] The male element 10 may contact with one or several springs which are located behind the male element 10 which is not shown here. During the axially movement of the gas cylinder the spring enable the male element 10 to move downwards to allow the gas cylinder 1 to approach the piercing member 5 for piercing the gas outlet. When the gas cylinder 1 is being removed from the piercing member 5 the male element 10 supports this movement by the compressed spring to eject the gas cylinder 1 from the piercing member 5. This actuation of the protection cap has the advantage that the piercing member 5 will only pierce the correct gas cylinder which is designed to be able to access into the piercing housing and push the male element 10 to meet the piercing member 5.

[0041] Figure 2 shows the connecting arrangement for the gas cylinder 1 and the piercing housing in a connected status. In this section view the gas cylinder 1 moves toward the piercing housing by threading the container 8 and the piercing housing together. The male element 10 is pushed backwardly by the female element 14 on the collar 2 and engages to the female element 14. From then on only an axial movement of the gas cylinder 1 relative to the piercing member 5 is possible. The primary seal element 3 fulfills the chamber 11 defined by the seal support element 7 that a radial expansion of the primary seal element 3 due to the compression is only restrained by the seal support element 7, namely the circular wall. As can be seen in the figure 2 the seal performance between the gas outlet 4 and the piercing member 5 is extremely enhanced by the primary seal element 3, the seal support element 7, the upper portion of the collar 2, the male element 10 and the side wall of the piercing housing 6. A multiple seal collar 2 is provided to maximal the seal performance between the piercing member 5 and the gas outlet 4 with a relative simple structure on which the said female element 14, the upper portion of the collar, the secondary seal element 9 are arranged.

[0042] Figure 3 shows an exterior view of the gas cylinder with the collar. On the neck of the gas cylinder 1 the collar 2 is arranged which carries the female element 14 and the secondary seal element 9. The female element 14 has two recesses which defined by an axial straight line and a curve so the gas cylinder 1 can orient itself to a correct position to be connected to the corresponding male element. The gas cylinder 1 having such a collar can be replaceable and single used.

[0043] Figure 4 shows a section view of the gas cylinder with the collar from the A-A view of the figure 3. The primary seal element 3 is so shaped in the inner space defined by the upper portion of the collar that a spacing 12 is provided between the primary seal element and the upper portion of the collar. As shown the spacing 12 is ring-shaped and is so large that the seal support element

arranged in the piercing housing can be fitted into. The primary seal element 3 comprises a broad portion and a narrow portion wherein the broad portion forms a seal with the gas outlet 4 of the gas cylinder by converting the gas outlet 4 completely and wherein the narrow portion defines the said ring-shaped spacing 12 with the upper portion of the collar 2. The narrow portion of the primary seal element is capable of being fitted into the chamber defined by the seal support element.

[0044] Figure 5 shows an exterior view of the gas cylinder 1 with the collar 2. The collar 2 comprises the secondary seal element 9, the female element 14, the upper portion, wherein the upper portion is taller than the female element 14 and the primary seal element 4. This multiple seal collar 2 has advantages that a reliable seal with the piercing member with relative simple arrangement is achieved and an undesirable damage of the seal elements due to the rotary movement between the gas cylinder and the piercing member is prevented. In addition, in use of the said arrangement a connection of an incorrect gas cylinder can be avoided.

[0045] In the piercing process the gas cylinder 1 received in the container 8 is connected with the piercing housing by threading the container onto the piercing housing. The female element 14 on the collar 2 pushes the male element 10 in the piercing housing backwardly and the primary seal element 3 is inserted into the chamber defined by the seal support element 7. By the continual threading of the container 8 the gas cylinder 1 is compressed onto the piercing member 5. The primary seal element 7 forms an axial seal and a radial seal between the piercing member 5 and the gas outlet 4. The radial expansion of the primary seal element 3 especially of the narrow portion of the primary seal element is restrained only by the seal support element 5 so that the radial seal performance is maximized.

[0046] The collar 2 has multiple functions that can prevent a rotary movement between the piercing member and the gas cylinder and it can forms a reliable seal between the piercing member and the gas outlet and between the collar and the side wall of the piercing housing. Also it prevents using an incorrect gas cylinder and also protects the primary seal element in transport and in handling.

Claims

1. A connecting arrangement for a gas cylinder having a neck with a side surface and a top surface including a gas outlet comprises,
 - a piercing housing for receiving the neck of the gas cylinder comprising an opening, a side wall and a bottom wall
 - a piercing member arranged in the piercing housing for piercing the gas outlet
 - a collar arranged on the neck of the gas cylinder

- having a side surface which extends above the top surface of the gas cylinder and defines an inner space, the inner space being delimited by the top surface of the gas cylinder and the collar,
 - a primary seal element arranged in the inner space forming a seal with the top surface of the gas cylinder
 - wherein the primary seal element is so arranged that a spacing is formed between the collar and the primary seal element
characterized in that a seal support element is arranged in the piercing housing defining a chamber between the seal support element and the piercing member having an opening in the direction of the opening of the piercing housing such that the primary seal element is inserted into the chamber when the piercing member is received in the collar to pierce the gas outlet and a radial expansion of the primary seal element in response to forming a seal with the piercing member is restrained in this chamber by the seal support element.
2. The arrangement according to claim 1, **characterized in that** the seal support element comprises a circular wall which surrounds the piercing member and extends axially from the bottom wall of the piercing housing in direction of the opening of the piercing housing, wherein the axial direction is the direction of the axis of the gas cylinder when the gas cylinder is being pushed into the piercing housing.
 3. The arrangement according to claim 1 or 2, **characterized in that** the primary seal element and the collar are unattached to the piercing member and the seal support element.
 4. The arrangement according to any one of the preceding claims, **characterized in that** the radial expansion of the primary seal element in response to forming a seal with the piercing member is restrained only by the seal support element and the piercing member.
 5. The arrangement according to any one of the preceding claims, **characterized in that** a space is provided between the seal support element and the side wall of the piercing housing where other connecting elements for connecting with the gas cylinder having the collar can be arranged.
 6. The arrangement according to claim 5, **characterized in that** the other connecting elements comprises a male element which corresponds a female element being arranged on the collar of the gas cylinder.
 7. The device according to claim 6, **characterized in that** the male element and its corresponding female element are so formed respectively in the piercing housing and on the collar that after engaging of the male and female elements a relative rotation between the gas cylinder and the piercing member is prevented.
 8. The device according to any one of the preceding claims, **characterized in that** a container is provided to receive the gas cylinder which comprises a connecting means to connect with the piercing housing.
 9. The device according to claim 8, **characterized in that** the side wall of the piercing housing has a thread on its exterior wall which can be connected with a thread on the internal wall of the container.
 10. The device according to any one of the preceding claims, **characterized in that** the collar comprises a secondary seal element on its side surface which is arranged to form a seal between the side wall of the piercing housing and the collar.
 11. The device according to claim 10, **characterized in that** the secondary seal is formed as an O-ring on the collar.
 12. The device according to claim 9 or 11, **characterized in that** a gas cylinder having a collar which defines the inner space to receive the primary seal element and on which the female element, the secondary seal element is arranged as claimed in the preceding claims, is provided.
 13. The device according to any one of the preceding claims, **characterized in that** a gas cylinder is provided which contains more than 21 vol.-% oxygen, preferably more than 80 vol.-% oxygen, more preferably more than 99 vol.-% oxygen.
 14. The device according to any one of the preceding claims, **characterized in that** the gas cylinder is portable.

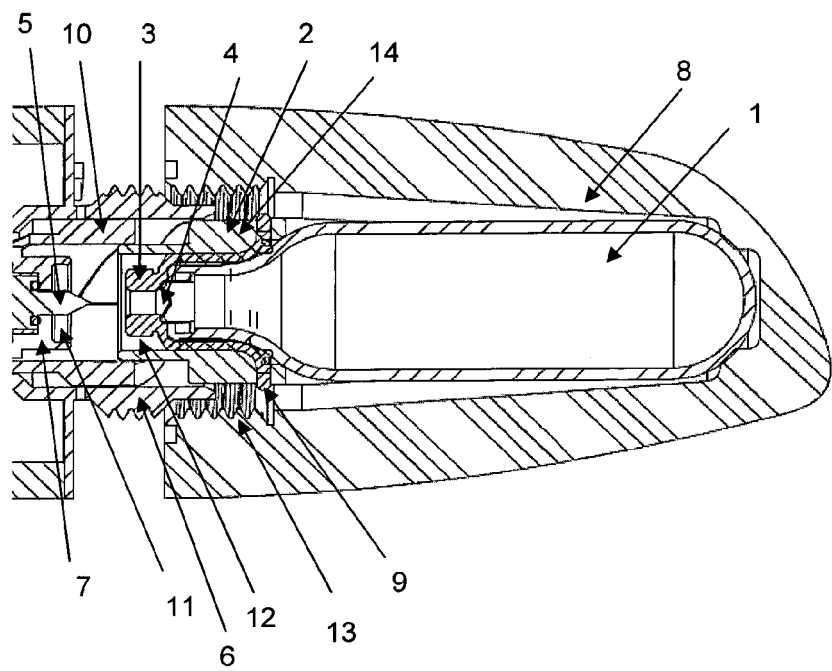


Fig. 1

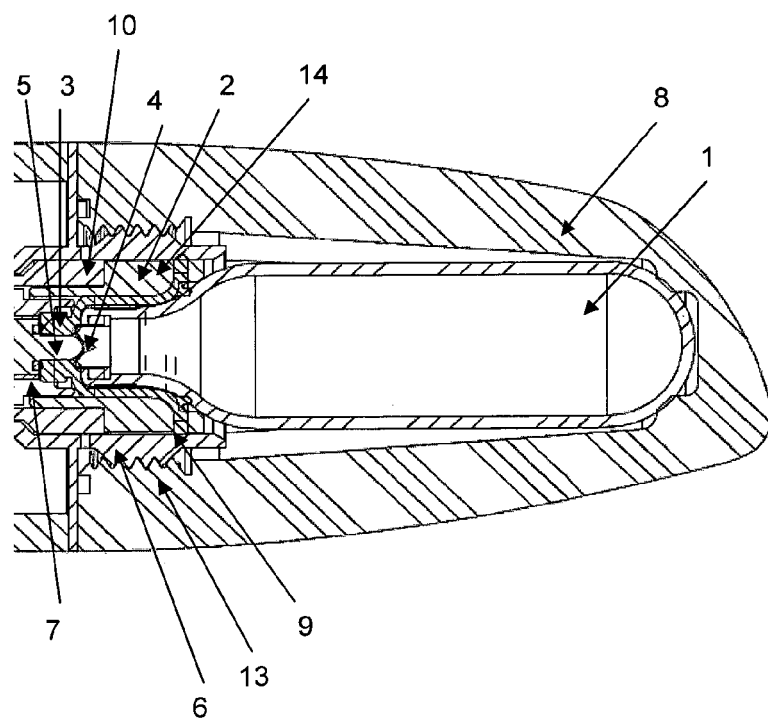


Fig. 2

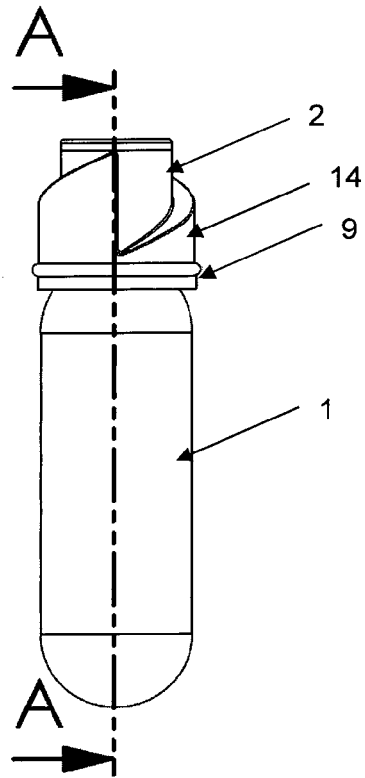


Fig. 3

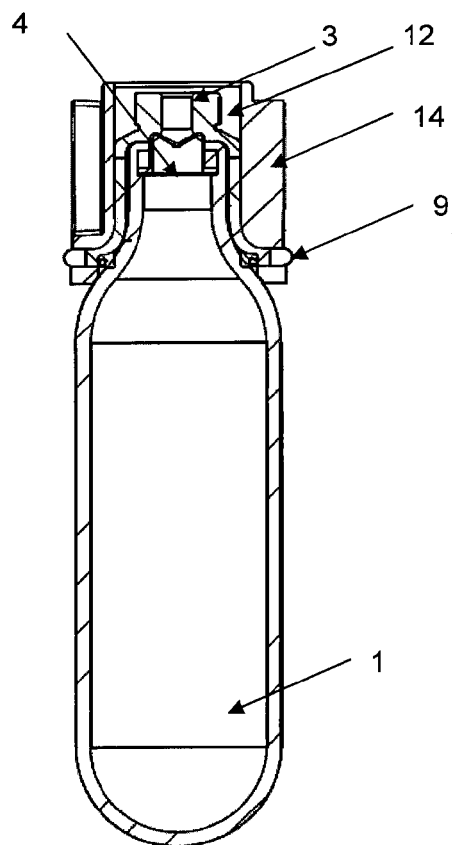


Fig.4

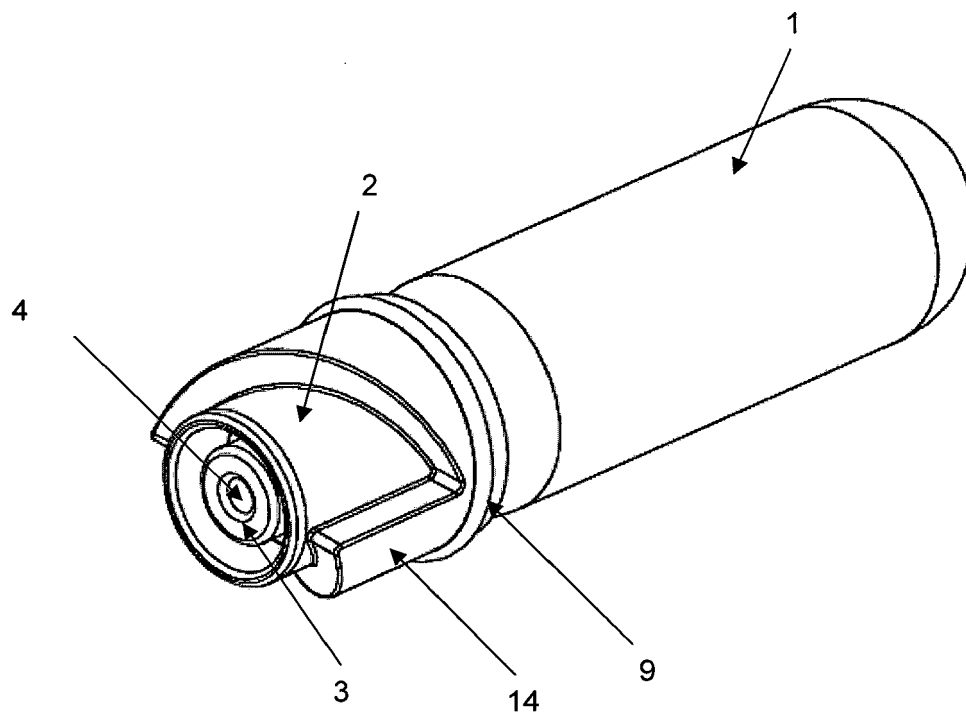


Fig. 5



EUROPEAN SEARCH REPORT

 Application Number
 EP 15 00 2420

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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