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(54) **VALVE TAMPER EVIDENT DEVICE FOR LIV MEDICAL PACKAGES**

(57) The present invention pertains to a valve securing device (10) for a gas cylinder valve, comprising a gripping portion (12) configured to engage a valve control element (320), a sleeve portion (14) defining an inner cavity (16) configured to receive a valve outlet, wherein the sleeve portion (14) is selectively switchable between a closed state enclosing the valve outlet and an opened state at least partially exposing the valve outlet, and a connecting element (18) arranged to prevent a movement of the gripping portion (12) relative to the sleeve portion (14). The sleeve portion (14) furthermore comprises a fixation element (140) to selectively close or open the sleeve portion (14), said fixation element (140) being configured to be irreversibly structurally modified, when the sleeve portion (14) is switched from the closed state to the opened state. Accordingly, the valve securing device (10) prevents an accidental gas release, e.g. during transportation, while at the same time providing a tamper evident device.

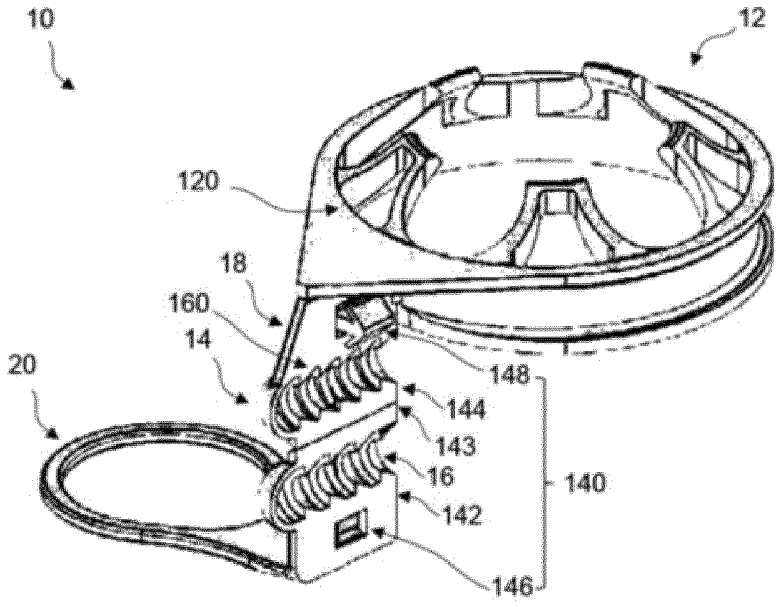


Figure 1

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Description

Technical Field

[0001] The invention relates to a valve securing device for a gas cylinder valve and, in particular, to a valve securing device to prevent a rotational movement of a valve control element and providing a tamper evident device.

Technological Background

[0002] Gas cylinders are frequently used in various applications including medical treatments to provide e.g. an inhalable medicament to a patient. In order to provide a required gas flow, such gas cylinders generally comprise a flow control knob to control a valve and to adjust the gas flow from the gas cylinder via a valve outlet. For such delicate precision elements a risk of inadvertent manipulation exists, in particular during transportation of the respective gas cylinder. For example, during transportation, the flow control knob may be accidentally operated, such that an unwanted gas release occurs while at the same time liquid or sediment particles may enter and/or contaminate the valve outlet of the gas cylinder, for example, when a corresponding sealing is accidentally removed, e.g. due to vibrations or collisions occurring during transport. Such unwanted gas release or leakage may furthermore result in potential explosion hazards, e.g., in the case of oxygen based mixtures, or in increased health risks, e.g., in the case of carbon monoxide, carbon dioxide, and/or nitric oxide based mixtures.

[0003] Furthermore, the removal of gas may occur due to voluntary actuation or operation of the flow control knob or operating wheel of the gas cylinder. For example, a user or operator may intermittently use a respective gas cylinder to provide a required gas flow, e.g., for testing a corresponding gaseous mixture, calibration of a gas application device, and/or for providing a medical treatment to a patient. Such actuation of the flow control knob may also be accidental, e.g., in a case where a plurality of gas cylinders are present and an incorrect gas cylinder is selected for a particular application. In either case, the fill level of the respective gas cylinder no longer corresponds to the original fill level while at the same time a contamination risk of the corresponding valve outlet is increased.

[0004] Although common technologies may provide a safety mechanism to protect e.g. the flow control knob and/or the valve outlet from damage, such technologies generally do not fully ensure that the flow control knob is in a closed state to prevent gas removal and furthermore provide no indication whether previous operation - either inadvertent or voluntary - has occurred and/or has caused a change in the gas fill level. For example, from US 1,948,966 a valve protector for gas containers is known, which comprises a solid cap enclosing the top end and the corresponding flow control knob of the gas cylinder. Although such a hinged arrangement of the cap or capsule may have advantages over common screw and thread arrangements, such cap does not secure a rotational movement of the flow control knob and furthermore does not provide an indication whether the control knob has previously been operated.

[0005] Accordingly, a need still exists to secure a respective flow control knob and to provide evidence of operation of a cylinder valve and a corresponding unwanted release of gas by its accidental actuation, e.g., during transportation, thereby improving safety.

Summary of the invention

[0006] It is an object of the present invention to provide an improved valve securing device for a gas cylinder valve that reduces the above problems.

[0007] This object is achieved by the valve securing device according to the features of the independent claims. Preferred embodiments are provided in the dependent claims and by the specification and the Figures.

[0008] Accordingly, in a first aspect, a valve securing device for a gas cylinder valve is suggested, which comprises a gripping portion configured to engage a valve control element and a sleeve portion defining an inner cavity configured to receive a valve outlet. The sleeve portion is selectively switchable between a closed state enclosing the valve outlet and an opened state at least partially exposing the valve outlet. The device furthermore comprises a connecting element arranged to prevent a movement of the gripping portion relative to the sleeve portion. The sleeve portion furthermore comprises a fixation element to selectively close or open the sleeve portion, wherein the fixation element is configured to be irreversibly structurally modified, when the sleeve portion is switched from the closed state to the opened state.

[0009] The securing of a gas cylinder valve is hence provided by preventing or at least impairing an operation or motion of the valve control element by means of the combined gripping portion and sleeve portion. As the sleeve portion is configured to accommodate at least a part of a valve outlet and is furthermore not movable relative to the gripping portion due to the connecting element, a movement of a respective valve control element, e.g. a flow control knob or wheel, is prevented, since the gripping portion engages the valve control element. In other words, when the sleeve portion is in a closed state and accommodates at least a part of the valve outlet, said sleeve portion may form an anchoring point for the gripping portion, wherein a configuration of the gripping portion provides an engagement with the valve control element, such that a force is exerted on the valve control element in a counteracting direction of the attempted operation direction.

[0010] It will be understood that the engagement between the gripping portion and the valve control element may be independent of the operation or attempted operation of the valve control element, such that the gripping

portion engages the valve control element upon assembly of the valve securing device. Alternatively, or in addition, the gripping portion may be configured such that said engagement is provided upon an initiation of an operation of the valve control element, e.g. by means of a spacing or particular tolerance, thereby only allowing a minimal operation or movement of the valve control element.

[0011] Preferably, the valve securing device is configured to prevent a rotational movement of the valve control element, such that e.g. a flow control knob or handling wheel may not be turned or at least may not be turned to the extent that a valve situated in the gas cylinder is actuated. Accordingly, the connecting element of the valve securing device is arranged such that a rotational movement of the gripping portion relative to the sleeve portion is prevented. However, it may optionally be provided that an axial or longitudinal movement of the gripping portion relative to the sleeve portion, e.g. in view of a longitudinal axis of a respective gas cylinder or of the valve securing device, is prevented or impaired, either additionally or alternatively to the rotational movement. The valve securing device hence prevents or at least significantly impairs an unintentional gas release, such that the operation safety and, in particular, the transportation safety of the respective cylinder are significantly improved. In other words, the valve securing device may function as an arrestor to prevent e.g. accidental operation of a flow control knob of a respective gas cylinder.

[0012] Furthermore, by means of the configuration of the sleeve portion and the corresponding fixation element the assembly of the valve securing device is greatly facilitated. For example, the sleeve portion may be positioned in an open state to enclose a part of a valve outlet, wherein the valve securing device may still be moved relative to the gas cylinder and the valve control element to position the valve securing device, such that the gripping portion engages the valve control element. To facilitate the assembly of the valve securing device the connecting element may e.g. provide an amount of tolerance with regard to a movement of the sleeve portion relative to the gripping portion, e.g., in an axial or rotational direction or in the form of a pivot, which facilitates the positioning of the sleeve portion around a valve outlet and to bring the gripping portion into engagement with a respective valve control element. The sleeve portion may then be simply switched to a closed state by means of the fixation element, thereby securing the valve control element and hence the valve of the respective gas cylinder.

[0013] In addition, the particular configuration of the fixation element provides that the sleeve portion may be easily switched from the opened state to the closed state, e.g. during assembly, but may not be switched back into the closed state after the valve securing device has been assembled and the initially closed sleeve portion has been subsequently opened. In other words, the sleeve portion may not be refitted once it has been disassembled since the disassembly or the opening of a closed sleeve portion causes a structural modification of the fixation element.

[0014] Accordingly, the valve securing device provides a tamper evident device, since a usage of the valve control element and/or the valve outlet requires that the sleeve portion of the assembled valve securing device has been opened. As the valve securing device cannot be re-assembled, this provides visual feedback that a respective gas cylinder may have been used by voluntarily opening the sleeve portion in order to actuate the valve control element, e.g. for a particular application. This furthermore significantly reduces the occurrence of inadvertent or accidental operation of a respective valve control element or the manipulation thereof.

[0015] By the same token, the provision of an intact and assembled valve securing device may provide a visual feedback to identify a respective gas cylinder that has been filled with a particular gaseous mixture and has not been used. The valve securing device may hence, for example, provide an unambiguous means for a user to visually identify and to distinguish filled gas cylinders from potentially used gas cylinders, e.g. at a plant filling site or at a location to perform an application.

[0016] The sleeve portion may furthermore provide that the valve outlet, e.g. a flow control outlet fir tree, is protected, for example, from impact damage and/or from contamination or contaminating particles entering the valve outlet. Accordingly, the sleeve portion is preferably configured to enclose a valve outlet. The part of the valve outlet to be enclosed may e.g. be only a distal or downstream portion or end of the valve outlet or may comprise the entire valve outlet extending from the gas cylinder, e.g. to provide protection for the entire valve outlet and to provide further rigidity and/or stability for the valve securing device. The sleeve portion may hence increase the cleanliness and integrity of the valve outlet, such that the operation and patient safety may be significantly increased.

[0017] Preferably, the sleeve portion comprises a first surface and a second surface that are pivotable relative to each other and face each other in the closed state, wherein the fixation element comprises a recess on the first surface and a corresponding protrusion on the second surface arranged to engage the recess in the closed state.

[0018] Accordingly, the sleeve portion may comprise two surfaces that are pivotably attached to each other and may be formed as essentially complementary surfaces, such that said surfaces provide an interface in the closed state. However, irrespective of the respective shape of the surfaces it may also be provided that the first and second surfaces are spaced apart from each other in the closed state, wherein the fixation element provides a fixation and engagement between the first and second surface, i.e. only in a particular region of the first and second surface. Preferably, the first and second surface are configured as essentially semicircular cylindrical

bodies that form an essentially cylindrical body in the closed state of the sleeve portion, such that the valve outlet may be received by the sleeve portion and may be in contact with an inner wall of the sleeve portion, either directly or via one or more protrusions or ribs. The sleeve portion may hence comprise a shape that essentially corresponds to the shape of the valve outlet. A cylindrical body has the advantage that an efficient dimensioning of the sleeve portion may be provided while at the same time a circular shape may provide a higher impact resistance, such that an improved protection of a valve outlet may be provided.

[0019] Furthermore, the first and second surface may comprise a region adjacent to the region receiving the valve outlet and which comprises the fixation element. This has the advantage that the geometry of the valve outlet receiving portion of the sleeve portion is not dependent on the fixation element while at the same time the securing of the sleeve portion, i.e. the closing of the sleeve portion, may be facilitated without directly affecting the valve outlet receiving portion of the sleeve portion. For example, in a spaced apart arrangement of the valve outlet receiving portion and the fixation element a larger force may be applied to the fixation element in order to close the sleeve portion without impairing the integrity of the valve outlet receiving portion or the valve securing device as a whole.

[0020] The pivoting arrangement may be provided by any suitable mechanical fixation, e.g. via a hinge or resilient or spring member. Such arrangement has the advantage that at least the sleeve portion may comprise multiple parts that are connected to each other, such that the assembly of the valve securing device may be facilitated. Furthermore, the pivoting of the sleeve portion facilitates the assembly of the sleeve portion on a valve outlet, such that the sleeve portion may be easily brought into the closed state and requires no further alignment or positioning of the first and second surface.

In order to further facilitate the securing of the sleeve portion the protrusion and the recess are preferably formed to provide a snap-fit arrangement in the closed state. To bring the protrusion into engagement with the recess, the fixation element may be configured to provide an amount of interference fit or friction fit during the assembly of the valve securing device. Accordingly, a force needs to be applied to secure the fixation element and bring the sleeve portion into a closed state. This has the advantage that the assembly of the valve securing device or a closed state of the sleeve portion may not accidentally occur. Furthermore, the snap-fit arrangement facilitates the securing of the sleeve portion into the closed state and provides a tactile feedback for a user operating the valve securing device. Furthermore, such snap-fit arrangement provides a positive fit, such that an inadvertent opening of a closed sleeve portion may be prevented.

[0021] In other words, the snap-fit arrangement ensures that the valve securing device once fitted to e.g. a filled gas cylinder cannot be refitted once it has been removed as the structure of the device is destroyed upon opening the sleeve portion. Accordingly, the device is configured as a single use device. To provide the snap-fit arrangement, the protrusion may be configured as or otherwise may comprise a detent, latch, and/or hook, which may engage a corresponding slot, tab, ridge, lug, or key of the recess. Furthermore, to facilitate the snap-fit arrangement, the protrusion and/or the recess may comprise a chamfered surface, such that a guiding surface is provided to facilitate the insertion of the protrusion into the recess.

[0022] In a preferred embodiment, the recess comprises an inner groove and the protrusion is shaped to provide a biasing force in a radial direction and to engage said groove with a surface of the protrusion facing the second surface in the closed state.

[0023] For example, the protrusion may be formed as a wedge or triangular shape having two sides extending radially outward and directed to the second surface in an angular position and configured as resilient members. Accordingly, when the protrusion is inserted into the recess, said radially extending sides may be biased radially inward, wherein said sides again extend radially outward after the protrusion has been fully inserted into the recess. Since the radially extending sides now engage a corresponding inner groove, e.g. formed by an inner ridge of the recess, a positive fit or snap-fit is provided, thereby preventing a removal of the protrusion from the recess. The protrusion hence may only be removed by exerting a force on the protrusion, e.g. a pulling force. The configuration of the fixation element, however, causes a deformation of the fixation element, such that the structure of the valve securing device is irreversibly modified.

[0024] For example, wedge-shaped sides of the protrusion may be formed of a resilient material and may be shaped, such that they may deflect inwardly upon insertion of the protrusion into the recess. However, once fitted the shape of the protrusion prevents that the wedge-shaped sides, which are biased radially outward, may deflect further outwardly upon exerting a pulling force on the fixation element, e.g. the first surface comprising the recess. Accordingly, instead of a deflecting of the wedge-shaped sides, the wedge-shaped sides and/or the inner groove of the recess may fold, tear, or break upon exerting a predetermined pulling force, thereby causing an irreversible structural modification of the valve securing device. By means of the structural modification a user may hence immediately observe that a valve control element and/or valve outlet has been used or tampered with.

[0025] The removal of the protrusion may hence cause a breakage of the protrusion or a breakage of the corresponding groove or recess, e.g. by means of a breakage line, such that the fixation element may not be refitted. However, alternatively, or in addition, the configuration of the valve securing device may also be provided, such that a removal of the protrusion causes a deformation of the sleeve portion and/or the connecting element. For

example, the valve securing device may comprise a portion, e.g. the connecting element and/or the sleeve portion, having a reduced material density and/or being formed, e.g. comprising a tapered shape, such that said portion tears or breaks upon exerting a predetermined force, when switching the sleeve portion from the closed state to the open state.

[0026] Furthermore, the protrusion may also be formed to engage the inner groove recess at an angle with regard to the second surface, e.g., in a perpendicular direction or in a direction corresponding to the biasing direction.

[0027] In order to facilitate the pivoting of the first surface relative to the second surface the first surface and the second surface are preferably connected via a hinge, more preferably a live hinge.

[0028] As described in the above, this has the advantage that the assembly of the valve securing device may be facilitated. In particular, a hinge may provide a mechanical restriction as to the relative movement, such that the sleeve portion may be easily brought into the closed state and requires no further alignment or positioning of the first and second surface. The hinge hence facilitates the assembly of the sleeve portion on a valve outlet. Furthermore, a live hinge, i.e. formed by a material of the sleeve portion, reduces the mechanical complexity and hence allows an easy manufacturing of the hinge.
To further facilitate the manufacturing and to reduce the complexity of the valve securing device, the connecting element may be formed by the first surface or second surface. In other words, the sleeve portion may be directly connected to the gripping portion and may form a bridging portion to provide a connecting surface. For example, a region of the first surface and/or the second surface that is not configured to receive a valve outlet may be provided that extends in a direction towards the gripping portion to form the connecting element. This further reduces the number of separate components of the valve securing device, which has the advantage that the stability and robustness of the valve securing device may be further increased.

[0029] Since the fixation element is configured to be irreversibly structurally modified when the sleeve portion is switched from the closed state to the opened state, the opening of the sleeve portion may be more difficult when compared to the closing of the sleeve portion. A user wanting to operate the valve outlet and/or the valve control element hence needs to exert a force on the fixation element in order to disassemble the valve securing device. To facilitate the opening of the sleeve portion, the sleeve portion therefore preferably comprises a pulling ring or strap to bias the sleeve portion from a closed state to an opened state.

[0030] Such pulling ring or strap may be directly connected to the fixation element or may be positioned on or be configured as an extension of a respective surface of the sleeve portion. For example, a pulling ring may be arranged at a distance of and in an essentially perpendicular angle to a portion of the sleeve receiving a valve outlet, such that leverage is provided to facilitate the opening of the sleeve portion. Furthermore, a pulling ring may be arranged in a direction in parallel to and preferably in an extending direction of the fixation element, such that a force may be directly applied to the fixation element. However, alternative arrangements of the fixation element and the pulling ring or strap are possible, for example, such that the pulling ring or strap exerts a force on the sleeve portion in a direction corresponding to a longitudinal axis of the sleeve portion, e.g., in a rotational direction.

[0031] As described in the above, the sleeve portion of the valve securing device is configured to receive at least a portion of a valve outlet. To ensure that the valve outlet or a respective gas tube is retained within the sleeve portion, the cavity preferably comprises a plurality of ribs configured to engage a thread or corresponding protrusions of the valve outlet. Furthermore, such ribs may have the advantage that both a further stability of the sleeve portion and an improved impact resistance with regard to the valve outlet are provided.

[0032] In addition, the ribs, which may be spaced apart at varying or equal distance may be formed of a resilient material, such that valve outlets with different dimensions may be received within the cavity, e.g. by means of a interference or press fit. Accordingly, the valve securing device may be adapted to various gas cylinders. By the same token, the spacing and dimensioning of the ribs may be chosen, such that the valve securing device is only adapted for a particular type of gas cylinder or valve outlet. This allows that the valve securing device may provide a visual indicator, e.g. by means of a particular coloring or key for a respective gas cylinder, such that a user may easily identify a required gas cylinder or valve type.

[0033] Independent of the particular configuration of the valve control device, the securing of a valve control element, e.g. a flow control knob or operating wheel is generally provided by the prevention of relative movement between the sleeve portion and the gripping portion. To facilitate the engagement of a respective valve control element by the gripping portion, the gripping portion preferably comprises a plurality of engaging elements that protrude radially inwards to engage corresponding protrusions or keys of the valve control element, wherein the engaging elements preferably are spaced apart at equal distance along a circumference of the gripping portion.

[0034] For example, the engaging elements may protrude both radially inward and in an axial direction, i.e. in a longitudinal direction of a respective gas cylinder, depending on the particular overall shape of a respective valve control element. Such engaging elements may hence be adapted to a respective valve control element, such that they may be positioned to prevent a movement of a valve control device, in particular to prevent a rotational movement. In order to provide a required stability of the engaging elements, said elements may be formed as solid elements or otherwise comprise a shape to pro-

vide sufficient structural stability, e.g. by means of an essentially truss or triangular shape. Such shape furthermore has the advantage that a chamfered surface is provided to guide the gripping portion during assembly. This furthermore has the advantage that the amount of material may be reduced, thereby reducing the manufacturing costs and the weight of the valve securing device.

The equal spacing of the engaging elements furthermore has the advantage that the positioning of the gripping portion on a respective valve control element is facilitated. However, alternatively, an asymmetrical arrangement of the engaging elements may also be provided, depending on the configuration of a respective valve control element. In either case, it is ensured that the valve securing device is positioned in the correct manner. Accordingly, the spacing between the engaging elements may correspond to a particular type of valve control element of a gas cylinder, such that a user may easily identify a required valve securing device having a configuration matching a respective gas cylinder or valve type and to further facilitate the correct assembly of the valve securing device. Furthermore, the symmetrical or asymmetrical spacing between the engaging elements facilitates the top-down assembly of the valve securing device, i.e. wherein the gripping portion is positioned in a first step and the sleeve portion is positioned and closed in a subsequent step. However, alternatively or in addition, it may also be provided that the correct positioning of the gripping portion is predetermined by the direction of the sleeve portion, such that the sleeve portion may be positioned in a first step, wherein the gripping portion is automatically correctly positioned upon positioning the sleeve portion on a valve outlet.

[0035] Preferably, the gripping portion comprises a substantially circular shape configured to receive the valve control element. Accordingly, the gripping portion may comprise e.g. an annular or ring shape that may enclose an outer circumference of a valve control element. This has the advantage that a guiding surface is provided to facilitate the assembly of the valve securing device while at the same time the circular shape may provide a protective element for the valve control element, such that damage occurring from impact, e.g., during transportation, may be reduced.

[0036] The circular shape of the gripping portion furthermore has the advantage that engaging elements may be formed along a circumference of the valve control element. For example, as described in the above, engaging elements may protrude radially inwards, such that the ring-shaped gripping portion may be easily positioned onto common valve control elements, e.g. flow control knobs or rotation wheels, in particular when the engaging elements are provided with equal spacing. Accordingly, the gripping portion may be simply turned and positioned, such that the sleeve portion is aligned with a valve outlets direction.

Alternatively, the circular shape of the gripping portion may be configured to be positioned at a top part of a valve control element, wherein engaging elements may protrude in a downward direction, i.e. in direction towards the gas cylinder, and/or a radially outwards direction. Preferably, the engaging elements may furthermore abut a bottom part of the valve control element or a top part of the gas cylinder. Such configuration may hence provide a cage construction, wherein the circular shape of the gripping portion provides a protective element in a longitudinal direction and the engaging elements provide protection in a radial direction.

[0037] The connecting element may furthermore be arranged substantially orthogonal to the sleeve portion and/or the gripping portion. Preferably, the connecting element is arranged substantially orthogonal to both the sleeve portion and the gripping portion. For example, the sleeve portion may extend in a radial direction corresponding to a longitudinal direction of the valve outlet while at the same time a valve control elements is generally provided at a top end of a gas cylinder. Accordingly, the gripping portion may be positioned on said top end in a direction perpendicular to the longitudinal axis of the gas cylinder.

[0038] To prevent a relative movement between the sleeve portion and the gripping portion in order to secure the valve control element the connecting element may be arranged e.g. in a direction corresponding to the longitudinal direction of the gas cylinder, such that the connecting elements is positioned substantially orthogonal to the sleeve portion and the gripping portion. Such arrangement has the advantage that the assembly of the valve securing device may be facilitated, e.g. by positioning the gripping portion in such a way that the sleeve portion, in an open state, may receive a valve outlet. Closure of the sleeve portion then ensures that the gripping portion may not be moved relative to the sleeve portion, since the connecting element is provided there between. Accordingly, although the connecting element may provide a low amount of tolerance, the connecting element is required to have a sufficient rigidity to prevent a relative movement.

[0039] Preferably, the gripping portion, the sleeve portion, and the connecting element are integrally formed, preferably formed as a single piece. Although said features of the valve securing device may also be provided as different parts, the integral configuration, and in particular a configuration as a single piece, has the advantage that the manufacturing of the valve securing device may be significantly facilitated. Furthermore, such configuration significantly increases the stability and rigidity of the device, such that the impact resistance may be further improved and the occurrence of accidental removal of the valve securing device may be reduced.

[0040] In order to further facilitate the manufacturing and to reduce the weight and material costs of the valve securing device, the gripping portion, the sleeve portion, and the connecting element are preferably made of an injection moldable polymer. By implementing injection molding it is furthermore possible to vary the material

density for particular regions of the valve securing device depending on the structural requirements of the respective feature. By the same token, injection molding may generally provide a homogeneous structure and provides the advantage that the shape of the valve securing device may be better adapted to the valve control elements and/or the valve outlet, such that an improved fitting is provided. Thereby, the securing of a valve control element and the protection of the valve control element and/or the valve outlet may be further improved.

[0041] Although each of the respective parts of the valve securing device may be formed individually by means of the injection molding, this furthermore facilitates the manufacturing of the valve securing device as a single piece. Accordingly, this has the advantage that no further steps are required and hence also during assembly a user is only required to position a single device and close the sleeve portion without any further considerations. Furthermore, providing the device by means of injection molding provides a very cost effective solution.

[0042] Preferably, the valve securing device is made of polypropylene, Nylon, and/or polyethylene. For example, the device may be made based on polypropylene, medium-density polyethylene, high-density polyethylene, Nylon 6, Nylon 66, or a combination thereof. This has the advantage that the overall costs are relatively low while at the same time the device may provide a required robustness to secure the valve control element. At the same time, this may still provide a certain tolerance for a movement between the sleeve portion and the gripping portion, which may facilitate the assembly of the valve securing device. Furthermore, use of these materials has the advantage that a live hinge may be provided for the sleeve portion, e.g., to facilitate the switching between the open position and the closed position. Although generally various polyethylene and/or polypropylene based materials as well as polyamide materials other than Nylon may be used, the use of Nylon, in particular Nylon 6 and/or Nylon 66, has the advantage that a proper balance between the required stiffness and flexibility may be provided.

[0043] To further adapt the valve securing device to the structural requirements, the injection moldable polymer is preferably a co-polymer, preferably an impact resistant grade co-polymer. Use of such polymers has the advantage that the valve securing device is sufficiently robust while the overall manufacturing costs may be kept low. In addition, the injection molding may comprise multiple polymer mixtures in order to provide e.g. a dual injection molding. This has the advantage that particular parts of the device may be provided with different structural characteristics, such that the structural stability may be further adapted to the particular requirements, e.g. in regard to the securing function and the fixation element.

[0044] According to a further aspect of the invention, a gas cylinder comprising a valve with a valve control element and at least one valve outlet is suggested, wherein the valve is secured by a valve securing device as described in the above.

In the assembled state, the valve securing device hence ensures that a movement of the valve control element is prevented due to the engagement of the gripping portion. For example, the valve control element may be configured as a flow control knob for handling wheel, wherein the gripping portion prevents a rotational movement thereof, such that a gas flow from the corresponding valve outlet is prevented. Accordingly, both the valve control element and valve outlet of the gas cylinder are protected from any inadvertent operation while at the same time the valve securing device may protect said elements from impact damage and furthermore facilitates the visual identification and inspection by providing a tamper evident device.

Brief description of the drawings

[0045] The present disclosure will be more readily appreciated by reference to the following detailed description when being considered in connection with the accompanying drawings in which:

Figure 1 is a schematic view of a valve securing device in an open state;

Figure 2 is a schematic view of the valve securing device according to Figure 1 in a closed state; and

Figure 3 is a schematic view of the valve securing device according to Figures 1 and 2 assembled to a gas cylinder valve.

Detailed description of preferred embodiments

[0046] In the following, the invention will be explained in more detail with reference to the accompanying figures. In the Figures, like elements are denoted by identical reference numerals and repeated description thereof may be omitted in order to avoid redundancies.

[0047] In Figure 1 a schematic view of a valve securing device 10 for a gas cylinder valve is shown having a sleeve portion 14 depicted in an open state. The sleeve portion 14 comprises a first surface 142 and a second surface 144 that each comprise a cavity 16, such that the sleeve portion 14 may receive at least a portion of a valve outlet (not shown). The cavity 16 may hence be adapted to a particular valve outlet of a respective gas cylinder and is shown in the embodiment according to Figure 1 having an essentially semicircular or semi-cylindrical shape. The cavity 16 furthermore comprises a plurality of ribs 160, which may furthermore secure a received valve outlet, e.g. by engaging a corresponding outer thread of the valve outlet.

[0048] Accordingly, when the sleeve portion 14 is switched into a closed state, the first surface 142 and the second surface 144 face each other, such that an essentially cylindrical shape or body of the cavity 16 is provided, wherein one end of the cavity has an opening corre-

sponding to the diameter of the cylindrical shape, whereas the other end is closed, such that the sleeve portion 14 forms a sealing enclosure. The cavity 16 may hence receive a valve outlet having a corresponding cylindrical shape, e.g., a tube section, wherein said valve outlet is protected from any contaminants entering the valve outlet by the closed end of the cylindrical body. Furthermore, the closed end of the cylindrical body may protect the received valve outlet against e.g. impact damage, which may occur during transportation and/or assembly of a respective gas cylinder. However, the closed end of the cylindrical body is merely optional, such that the sleeve portion may also comprise a cavity 16 having two open ends.

[0049] In order to switch the sleeve portion 14 from an open state to a closed state a hinge 143 is provided, which connects the first surface 142, with the second surface 144, and allows a pivoting of the first surface 142 relative to the second surface 144. The hinge 143 is depicted as a continuous hinge 143 between the ends of the cavity 16. This has the advantage that the first surface 142 and the second surface 144 are aligned with respect to each other and no further positioning is required to bring the sleeve portion 14 into a closed state. Although a variety of hinges may be provided the hinge 143 according to Figure 1 is formed as a live hinge, i.e. a hinge provided by a resilient material, such as a polymer-based material.

[0050] To close the sleeve portion 14 a fixation element 140 is provided, which according to the embodiment in Figure 1 comprises a protrusion 148 and a corresponding recess 146. Although the protrusion 148 and the recess 146 are depicted being positioned on the second surface 144 and the first surface 142, respectively, alternative configurations may be provided. The protrusion 148 is furthermore provided on a portion of the second surface 144 forming the connecting element 18. Accordingly, although this is merely optional, the second surface 144 and the connecting element 18 are integrally formed. In other words, the connecting element 18 is provided by the second surface 144.

[0051] Upon switching the sleeve portion 14 into the closed state the protrusion 148 engages the recess 146 in order to securely fix the sleeve portion 14. The protrusion 148 is configured as an essentially wedge-shaped or arrow-shaped protrusion 148 having two sides extending radially outward and directed to the second surface 144 in an angular position and configured as resilient members. The two sides of the protrusion 148 hence serve as a guiding surface to facilitate the insertion of the protrusion 148 into the recess 146. Accordingly, when the protrusion 148 is inserted into the recess 146, said radially extending sides are biased radially inward, wherein said sides again extend radially outward after the protrusion 148 has been fully inserted into the recess 146. The radially extending sides now engage a corresponding inner groove (not shown), which is formed as an inner ridge of the recess 146, such that a positive fit in the form of a snap-fit is provided. By means of this positive fit, an accidental removal of the protrusion 148 from the recess 146 is prevented and the sleeve portion 14 may not simply be opened.

[0052] The protrusion 148 hence may only be removed by exerting a force on the protrusion 148 or on the recess 146, e.g. a pulling force, as the sides of the protrusion 148 that deflect inwardly upon insertion of the protrusion 148 into the recess 146 are biased radially outward once fitted yet do not deflect further outwardly upon exerting a pulling force on the fixation element 140, e.g. the recess 146. Accordingly, instead of a further deflection of the wedge-shaped sides, the wedge-shaped sides engage the inner groove of the recess 146 with a surface or edge facing the second surface 144, such that the wedge-shaped sides and/or the inner groove of the recess 146 tear or break upon exerting a predetermined pulling force, thereby causing an irreversible structural modification of the sleeve portion 14 and the valve securing device 10 as a whole. The removal of the protrusion 148 from the recess 146 hence causes a breakage of the protrusion 148 and/or a breakage of the corresponding groove or recess 146, e.g. by means of a breakage line, such that the fixation element 140 may not be refitted. Although not depicted in further detail in Figure 1, the protrusion 148 and/or the inner groove of the recess 146 may be formed with a portion comprising a tapered shape forming a breaking line, such that said portion tears or breaks upon exerting a predetermined force, when switching the sleeve portion 14 from the closed state to the open state.

[0053] The snap-fit arrangement hence ensures that the valve securing device 10 once assembled or fitted to e.g. a filled gas cylinder cannot be refitted once it has been removed as the structure of the device 10 is destroyed upon opening the sleeve portion 14. By means of the structural modification a user may hence immediately observe that a valve control element and/or valve outlet (not shown) has been used or tampered with.

[0054] Once fitted, i.e. once the sleeve portion 14 is in the closed state, the sleeve portion 14 hence forms an anchor point around a valve outlet. A gripping portion 12, which is connected to the sleeve portion 14 via the connecting element 18 of the second surface 144, may hence be secured, such that a valve control element (not shown) engaged by the gripping portion 12 may not be moved. The securing of the valve control element may hence be provided by a combination of the engagement of the gripping portion 12 and the anchoring of the valve securing device 10 by means of the closure of the sleeve portion 14. Furthermore, the connecting element 18, which bridges the sleeve portion 14 and the gripping portion 12, provides a stability and/or rigidity of the valve securing device 10, such that only a minimal movement of the gripping portion 12 relative to the sleeve portion 14 is allowed. In other words, a minimal tolerance may be provided, which facilitates the assembly of the valve securing device 10 to a respective gas cylinder, but which ensures that a valve control element may not be operated, when the

valve securing device 10 is fitted.

The connecting element 18 is furthermore depicted to be arranged in an orthogonal or perpendicular direction with respect to the gripping portion 12. This furthermore provides stability in a longitudinal direction of a respective gas cylinder, such that the gripping portion 12 may not accidentally disengage a respective valve control element. Furthermore, the engagement of a valve control element by the gripping portion 12 is provided according to the embodiment by a plurality of engaging elements 120 that protrude in a radially inward direction. In addition, said engaging elements 120 are also oriented at an angle with respect to a longitudinal axis of a respective gas cylinder, such that the positioning of the gripping portion 12 may be facilitated. The optional truncated end of the engaging elements 120 provides that a guiding or chamfered surface may be provided while at the same time the engagement stability with regard to the valve control element is increased. The non-solid structure of the engaging elements 120 furthermore not only reduces the weight of the valve securing device 10, but also provides a low level of flexibility or resilience to further facilitate the positioning of the gripping portion 12.

[0055] The optional ring shape or circular shape of the gripping portion 12 furthermore provides that the gripping portion 12 may receive and/or enclose a valve control element to provide further protection and stability of the valve control element, e.g. against impact damage. However, other configurations and shapes of the gripping portion, e.g. polygonal shapes, such as hexagonal or octagonal shapes, may be provided.

[0056] To facilitate the opening of the valve securing device 10 after said device has been assembled or fitted, the valve securing device 10 furthermore comprises a pulling ring 20, which is attached to the first surface 142 of the sleeve portion 14. Accordingly, the pulling ring 20 is essentially arranged in an extending direction of the protrusion 148 and the recess 146, such that a pulling force may be directly exerted on the fixation element 140. Furthermore, the pulling ring 20 is arranged at a distance from the hinge 143, such that leveraged is provided with regard to the sleeve portion 14, in particular, the hinge 143. However, other arrangements of the pulling ring 20 may be provided, depending on the configuration of the sleeve portion 14 and the fixation element 140. Optionally, the gripping portion 12, the sleeve portion 14, and the connecting element 18 are integrally formed as a single piece. Furthermore, the gripping portion 12, the sleeve portion 14, and the connecting element 18 are made of an injection moldable polymer, e.g. a co-polymer based on polyethylene, Nylon, and/or polypropylene. The polymer is optionally of an impact resistant grade type, such that the valve securing device 10 provides improved protection for the valve components of a respective gas cylinder and provides a structural stability, which may be required, e.g. during transportation. The polymer basis furthermore provides that the hinge 143 is configured as a live hinge.

[0057] The configuration of the valve securing device 10 as a single piece has the advantage that the manufacturing of the valve securing device 10 may be significantly facilitated. Furthermore, such configuration significantly increases the stability and rigidity of the device, such that the impact resistance may be further improved and the occurrence of accidental removal of the valve securing device 10 may be reduced. Furthermore, the injection molding provides that the manufacturing is further facilitated in a very cost effective manner and reduces the weight and material costs of the valve securing device 10.

[0058] The valve securing device 10 according to Figure 1 is depicted in the closed state in Figure 2. Accordingly, it is shown how the essentially cylindrical body of the sleeve portion 14 provides an enclosure for a valve outlet, wherein the first surface and second surface of the sleeve portion 14 face each other. In the closed state of the sleeve portion 14, the protrusion on the second surface is received by the recess on the first surface and engages said recess, such that an opening of the sleeve portion 14 may not occur unless a predetermined force is exerted on the sleeve portion 14. As described in the above, the pulling ring 20 facilitates such opening while at the same time such arrangement provides a compact design of the valve securing device 10.

In Figure 3 the valve securing device 10 according to Figures 1 and 2 is shown in an assembled or fitted state on an integrated valve 300. Accordingly, the gripping portion 12 engages a valve control element 320 by means of a plurality of engaging elements 120, which are spaced apart at equal distance along a circumference of the gripping portion 12. The gripping portion 12 hence receives the valve control element 120, which is configured as a flow control knob. The radially inward protruding engaging elements 120 are depicted to engage corresponding keys 322 or slots of the flow control knob. In this configuration the valve securing device is also formed as a single piece by means of injection molding, such that the engaging elements may match a surface and angle of said keys 322 and may provide a frictional fit or press fit by means of a corresponding resilience of said engaging elements 120.

[0059] In addition, the valve control element 320 of the integrated valve 300 comprises a plurality of protrusions 324 that are arranged between the keys 322. Accordingly, the engaging elements 120 are arranged in such a way that, when a user attempts to operate or actuates the valve of the gas cylinder via the valve control element 320, the plurality of protrusions 324 engage the corresponding plurality of engaging elements 120. Since in the closed state of the sleeve portion 14, the sleeve portion 14 forms an anchor point for the valve securing device, movement of the valve control element 320 is prevented. According to the embodiment, such movement corresponds to a rotational movement of a flow control knob. However, other valve control elements and hence also other movement directions may be prevented, de-

pending on the corresponding configuration of the valve securing device.

[0060] By the same token, movement of the valve control element 320 is only possible, when the valve securing device is removed, i.e. by opening the sleeve portion 14 by pulling the pulling ring 20, such that the protrusion disengages the recess of the fixation element. Accordingly, the movement of the valve control element 320 requires a voluntary operation by a user, such that an inadvertent or accidental operation hence may be prevented. Since the opening of a once fitted valve securing device results in a structural modification of the valve securing device, e.g. of the fixation element, the opening of the fitted valve securing device is irreversible. Therefore, the valve securing device facilitates the visual identification and inspection by providing a tamper evident device.

[0061] It will be obvious for a person skilled in the art that these embodiments and items only depict examples of a plurality of possibilities. Hence, the embodiments shown here should not be understood to form a limitation of these features and configurations. Any possible combination and configuration of the described features can be chosen according to the scope of the invention.

List of reference numerals

[0062]

10	Valve securing device
12	Gripping portion
120	Engaging element
14	Sleeve portion
140	Fixation element
142	First surface
143	Hinge
144	Second surface
146	Recess
148	Protrusion
16	Cavity
160	Ribs
18	Connecting element
20	Pulling ring
300	Integrated valve
320	Valve control element
322	Key
324	Protrusion

Claims

1. Valve securing device (10) for a gas cylinder valve, comprising:

   - a gripping portion (12) configured to engage a valve control element (320),
   - a sleeve portion (14) defining an inner cavity (16) configured to receive a valve outlet, wherein the sleeve portion (14) is selectively switchable between a closed state enclosing the valve outlet and an opened state at least partially exposing the valve outlet, and
   - a connecting element (18) arranged to prevent a movement of the gripping portion (12) relative to the sleeve portion (14),

   wherein the sleeve portion (14) furthermore comprises a fixation element (140) to selectively close or open the sleeve portion (14), said fixation element (140) being configured to be irreversibly structurally modified, when the sleeve portion (14) is switched from the closed state to the opened state.

2. Valve securing device (10) according to claim 1, wherein the sleeve portion (14) comprises a first surface (142) and a second surface (144) that are pivotable relative to each other and face each other in the closed state, wherein the fixation element (140) comprises a recess (146) on the first surface (142) and a corresponding protrusion (148) on the second surface (144) arranged to engage the recess (146) in the closed state.

3. Valve securing device (10) according to claim 2, wherein the protrusion (148) and the recess (146) are formed to provide a snap-fit arrangement, preferably a positive fit, in the closed state.

4. Valve securing device (10) according to claim 2 or 3, wherein the recess (146) comprises an inner groove and wherein the protrusion (148) is shaped to provide a biasing force in a radial direction and to engage said groove with a surface of the protrusion (148) facing the second surface (144) in the closed state.

5. Valve securing device (10) according to any of the claims 2 to 4, wherein the first surface (142) and the second surface (144) are connected via a hinge (143), preferably a live hinge.

6. Valve securing device (10) according to any of the claims 2 to 5, wherein the connecting element (18) is formed by the first surface (142) or second surface (144).

7. Valve securing device (10) according to any of the preceding claims, wherein the sleeve portion (14) comprises a pulling ring (20) or strap to bias the sleeve portion (14) from a closed state to an opened state.

8. Valve securing device (10) according to any of the preceding claims, wherein the cavity (16) comprises a plurality of ribs (160) configured to engage a thread or corresponding protrusions of the valve outlet.

9. Valve securing device (10) according to any of the preceding claims, wherein the gripping portion (12) comprises a plurality of engaging elements (120) that protrude radially inwards to engage corresponding protrusions (324) or keys (322) of the valve control element (320), said engaging elements (120) preferably being spaced apart at equal distance along a circumference of the gripping portion (12).

10. Valve securing device (10) according to any of the preceding claims, wherein the gripping portion (12) comprises a substantially circular shape configured to receive the valve control element (320).

11. Valve securing device (10) according to any of the preceding claims, wherein the connecting element (18) is arranged substantially orthogonal to the sleeve portion (14) and/or the gripping portion (12).

12. Valve securing device (10) according to any of the preceding claims, wherein the gripping portion (12), the sleeve portion (14), and the connecting element (18) are integrally formed, preferably formed as a single piece.

13. Valve securing device (10) according to any of the preceding claims, wherein the gripping portion (12), the sleeve portion (14), and the connecting element (18) are made of an injection moldable polymer, preferably made of polypropylene and/or polyethylene, in particular high density polyethylene or medium density polyethylene, and/or Nylon.

14. Valve securing device (10) according to claim 13, wherein the injection moldable polymer is a co-polymer, preferably an impact resistant grade co-polymer.

15. Gas cylinder comprising a valve (300) with a valve control element (320) and at least one valve outlet, wherein the valve is secured by a valve securing device (10) according to any of the preceding claims.

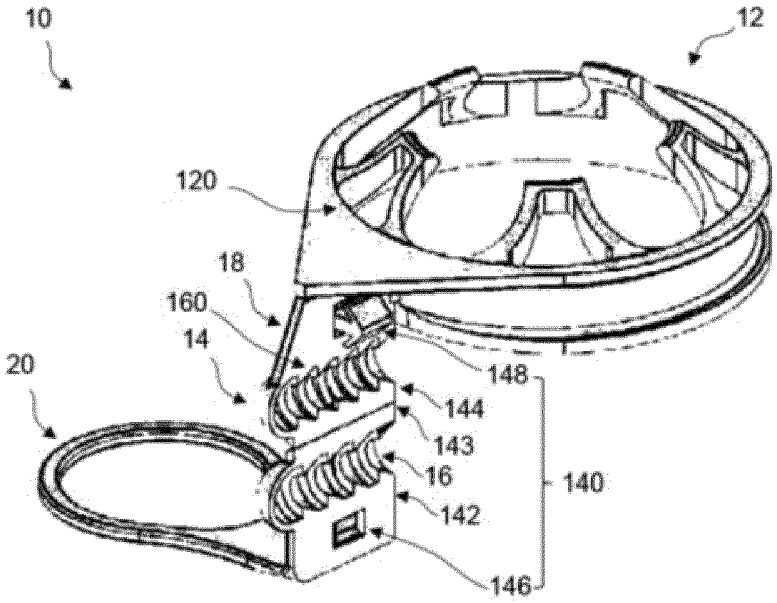


Figure 1

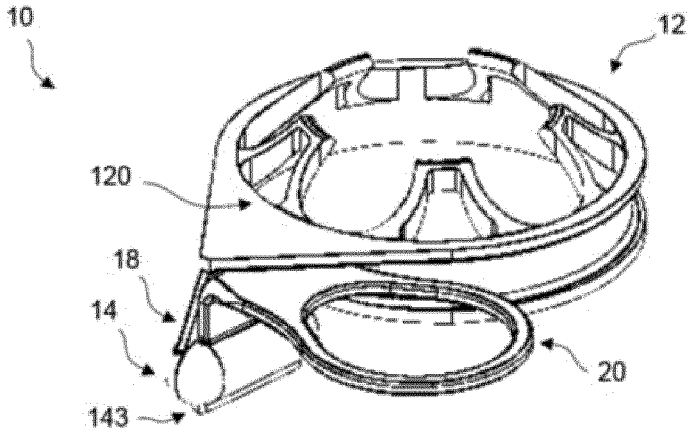


Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 9955

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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TECHNICAL FIELDS SEARCHED (IPC)

F17C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 June 2019	Forsberg, Peter

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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REFERENCES CITED IN THE DESCRIPTION

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