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(54) **Safety device for explosive containers, explosive containers and method for making explosive containers safe**

Sicherheitsvorrichtung für explosive Behälter, explosive Behälter und Verfahren zur Herstellung der Sicherheit explosiver Behälter

Dispositif de sécurité pour des récipients pour explosifs, récipients pour explosifs et procédé de sécurisation pour récipients pour explosifs

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Description

[0001] The present invention relates to a safety device for explosive containers, a relative explosive container and a method for making explosive containers safe; in particular the present invention is preferably applied in the field of insensitive munition explosive of the IM (Insensitive Munition) type.

[0002] Insensitive explosives are characterised in that they do not explode suddenly when directly reached by a flame or in any case when subject to a high and/or sudden increase in temperature. Such explosives, like all explosives, have a priming temperature above which they decompose, releasing amounts of gas; such gases must be readily ejected from the explosive containment chamber to prevent too high overpressures from causing the breakage of the enclosure and also the decomposition and consequent explosion/detonation. The strength and the time of reaction depend on the type of explosive used.

[0003] In the field of insensitive explosives it is therefore known to use safety devices suitable for favouring the discharge of gases generated before the critical priming temperature is reached, preventing strong reactions or, in any case, limiting the reaction strength as much as possible.

[0004] Known devices for example envisage the use of closing caps or rings made of a material having a melting point calibrated for allowing the cap, in the proximity of critical temperatures for the explosive, to melt and free venting apertures suitable for allowing the gas discharge so as to prevent the pressure in the explosive containment chamber from reaching limit values. Such devices are known from US-A-5155298, US 2003/205161 A1, US H1144H.

[0005] The devices of the prior art do not ensure optimum behaviour both in conditions of storage and/or transport of the explosive container and in conditions of high overheating.

[0006] In fact, during storage or transport, the explosive containers are often subject to string mechanical stresses, such as shocks or vibrations, which could dangerously crack the caps. In fact, such caps have considerable masses and are made of metal alloys that at ambient temperature are quite fragile.

[0007] Moreover, in the case of melting of the caps subsequent to strong overheating, often the caps of the prior art do not ensure suitable opening of the gas vents, but have metal parts that stick at the vents without ensuring suitable gas discharge.

[0008] Starting from US 2003/205161 A1, the problem that the present invention intends to solve is to make a safety device which solves the disadvantages mentioned with reference to the prior art, and in particular a device which ensures quick and effective gas discharge following a prolonged exposure of the container to a high overheating of the surrounding environment and at the same time good mechanical resistance in all the conditions of storage and/or transport of the explosive container.

[0009] Such disadvantages are solved by a safety device in accordance with claim 1.

[0010] Other embodiments of the safety device according to the invention are described in the subsequent claims.

[0011] Further features and advantages of the present invention will appear more clearly from the following description of a preferred non-limiting embodiment, wherein:

[0012] figure 1 shows a section view of an explosive container comprising a safety device according to an embodiment of the present invention;

[0013] figure 2 shows a section view of an explosive container comprising a safety device according to a further embodiment of the present invention;

[0014] figure 3 shows a section view of a further embodiment of the safety device of the present invention.

[0015] With reference to the above figures, reference numeral 4 generally relates to a safety device for containers 8 of explosive substances.

[0016] Containers 8 of explosive substances for example comprise a chamber 12 for receiving the explosive substance, preferably hydraulically or pneumatically sealed, delimited by at least one closing wall 16. The closing wall 16 has a venting aperture 20 suitable for seating at least partly device 4. Preferably, the venting aperture 20 has a circular or in any case axial-symmetric shape relative to a symmetry axis X-X.

[0017] Advantageously, device 4 comprises at least one closing body 28 suitable for hermetically closing the venting aperture 20.

[0018] Preferably, the closing body 28 is countershaped relative to the venting aperture 20; for example, the closing body 28 is shaped as a disc.

[0019] Device 4 comprises retain means 34 of the closing body 28, mechanically separate from the closing body 28, and suitable for constraining the closing body 28 on the venting aperture 20.

[0020] According to an embodiment, the retain means 34 comprise a melting element 38, suitable for melting for releasing the closing body 28, in the case of overheating of the environment surrounding the container of explosive material; the melting element 38 in an assembled configuration interferes at least partly with the closing body 28 for preventing the extraction of the closing body 28 from the containment chamber 12.

[0021] Preferably, the melting element 38 has a ring shape, so that in an assembled configuration it is axial-symmetrical relative to axis X-X of aperture 20.

[0022] Advantageously, the retain means 34 comprise an abutment element 42 that in an assembled configuration interferes with the melting element 38 so as to lock the melting element 38 into position against the closing body 28.

[0023] Thus, the melting element 38, in an assembled configuration, is preloaded in compression between the abutment element 42 and the closing body 28, according

to an axial direction parallel to said axis X-X of aperture 20.

[0024] According to a possible embodiment, the abutment element 42 comprises a first plate 48 suitable for influencing in compression a portion of melting element 38 in contact with the closing body 28.

[0025] Preferably, the first plate 48 is substantially counter-shaped relative to the closing body 28 so as to have external overall dimensions smaller than or equal to, the overall dimensions of the closing body 28.

[0026] According to an embodiment the first plate 48 and the closing body 28 are shaped as discs having substantially the same diameter.

[0027] Preferably, the abutment element 42 is mechanically constrained to the closing body 28 by constraining means, such as for example removable connections of threaded type 52. According to a further embodiment (figure 3), the abutment element 42 is not mechanically constrained to the closing body 28 but to the closing wall 16. The closing wall 28 is directly seated in a first seat 53 obtained in the thickness of wall 16 and delimited by a stopping edge 54 that axially constrains the closing body against the wall 16.

[0028] According to a possible embodiment, the constraining means comprise spacer bushes 56 arranged between the first plate 48 and the closing body 28. Bushes 56 are preferably inserted coaxially to the threaded connections 52 and have the function of preventing bending deformations of the closing body or of the first plate.

[0029] According to a possible embodiment, a venting valve 60 is inserted between the first plate 48 and the closing body 28, suitable for intercepting the gases of the containment chamber 12 and ejecting them outside said chamber 12, as a limit pressure value is exceeded.

[0030] According to an embodiment, the abutment element 42 comprises a second plate 64 suitable for influencing in compression a portion of the melting element 38 in contact with a portion of said closing wall 16 or with a support flange 80 of device 4, as better described hereinafter. The first and the second plate 48, 64 are mechanically separate from each other.

[0031] Preferably, the first plate has a disc shape, counter-shaped relative to the closing body 28, and the second plate 64 has the shape of a circular crown, having an inside diameter larger than the outer diameter of the first plate 48 and of the closing body 28.

[0032] According to an embodiment variation (figure 2), the melting element 38 comprises at least one guiding rib 68 suitable for facilitating the coupling between element 38 itself and at least one between the closing body 28 and the first plate 48. In other words, the edge forms a containment guide of the closing body 28 and of the first plate 48.

[0033] According to an embodiment, the melting element 38 comprises a bismuth-tin alloy, having a melting point comprised between 135 °C and 145 °C.

[0034] Preferably, the melting element is made of an eutectic bismuth and tin alloy having a melting point equal to 138 °C.

[0035] According to an embodiment variation, the melting element 38 comprises high molecular density polyethylene (HDPE) having a melting point equal to about 135 °C.

[0036] Preferably, the melting element 38 is a ring having a dimensional ratio between a radial thickness and an axial thickness greater than or equal to 1; and more in particular, said dimensional ratio is comprised between 2 and 2.5. By axial thickness it is meant a thickness measured along a direction parallel to axis X-X of the venting aperture 20. By radial thickness it is meant a thickness measured along a radial direction perpendicular to axis X-X and incident therewith.

[0037] The closing body 28 is preferably made of aluminium so as to allow good resistance to the inside pressures of the chamber and at the same time limit the weight of the component itself; the mass containment is useful for limiting the stresses that subsequent to shocks and/or vibrations the closing body 28 would transmit to the retain means 34, 38, 42.

[0038] Advantageously, device 4 comprises sealing means 74 suitable for ensuring the hydraulic seal of the containment chamber 12. For example said sealing means 74 comprise at least one O-ring 76 arranged between the closing wall 16 and the closing body 28 (figure 3).

[0039] According to a further example, the sealing means 74 comprise at least one 0-ring 76 arranged between the closing body 28 and the melting element 38 (figure 1).

[0040] According to a possible further embodiment, device 4 comprises a flange 80 suitable for being inserted in the venting aperture 20 and for seating at least partly the closing body 28, so as to sealingly close, together with the closing body 28, the venting aperture 20 (figures 1-2).

[0041] For example flange 80 can comprise a fixing collar 84 suitable for making an abutment against the closing wall 16 in the insertion of flange 80 in aperture 20 and for allowing the fixing of flange 80 to said closing wall 16, for example by threaded connections 52.

[0042] Preferably, a sealing ring, such as an O-ring 76, is inserted between collar 84 and the closing wall 16.

[0043] Flange 80 delimits a second seat 86 for seating said melting element 38. It is possible to provide for a second flange 90 coaxial relative to flange 80, for example for adapting the dimensions of the device to those of the venting aperture 20.

[0044] The operation of a safety device according to the present invention shall now be described.

[0045] In conditions of normal operation or transport or storage, the device and the relative explosive container are normally exposed to a temperature comprised between -40 °C and +70 °C.

[0046] In the presence of any shocks or vibrations, the melting ring is in a tensional pre-compression state, so that any tensile stress, for example due to bending stress-

es, are annulled or in any case dampened or reduced by said tensional state.

[0047] Any gases released inside the containment chamber 12 cannot exit therefrom, since chamber 12 is completely sealed. The bending stresses induced by such gases are withstood by the closing body 28 and by the retain means 34, 38, 42 and any tensional traction states are at least partly annulled by said tensional compression state.

[0048] Moreover, since the melting ring has a geometry of 'stocky' body, such component is essentially stressed by shearing actions rather than bending actions. Such geometry increases the mechanical resistance of the component to even impulsive stresses optionally combined with pressure actions of the gases inside the chamber.

[0049] If the external temperature reaches the melting point of the melting element 38, normally equal to about 138 °C, said melting element 38 melts.

[0050] Following the melt, the retain means 34,38,42 are not capable anymore of locking the closing body 28, since the melting disc melts, and the closing body tends, also thanks to its weight, to fall and exit from the relative seat, freeing the venting aperture 20 for the gases contained in chamber 12; optionally, the thrust action of the gases themselves can favour the ejection of the closing body 28.

[0051] Moreover, the first plate 48 represents a mass integral to the closing body 28, positioned externally relative to aperture 20 and to the containment chamber 12, thus the overall barycentre of the closing body 28 and first plate 48 system is external to the containment chamber 12 and favours the fall by gravity of the closing body 28.

[0052] The exit of the closing body 28 from the seat thereof does not exhibit risks of sticking that could lock it on aperture 20, closing at least partly the gas outlet section: in fact, after the melting of the ring, the passage section available for the closing body increases, since the closing body meets a passage section of the second plate 64 or of flange 80 that are greater than the dimensions of the closing body 28 and of the first plate 48.

[0053] Moreover, the closing body is normally mounted with slight clearance relative to the relevant aperture, since the locking into position of the body itself takes place through the retain means 34,38,42 and the hermetic seal of the gases is obtained by special seals.

[0054] The method for making explosive containers safe according to the present invention shall now be described.

[0055] In particular, the safety devices according to the present invention can be advantageously applied also the existing explosive containers either without safety devices and provided with little effective safety devices.

[0056] The method consists in determining an existing venting aperture on a wall 16 of the containment chamber 12 of the explosive container. As an alternative, said venting aperture 20 is made on a closing wall 16 of the containment chamber 12 of the explosive material.

[0057] A safety device 4 according to the present invention is then sealingly inserted in said venting aperture 20.

[0058] Advantageously, the device may be inserted in a pre-assembled configuration, that is, having already mechanically connected the melting element 38, the closing body 28, the abutment element 42 and any flanges 80, 90 to one another.

[0059] As it can be understood from the description, the safety device according to the present invention allows overcoming the disadvantages of the prior art safety devices.

[0060] The device has a small mass as compared to the melting discs of the prior art; in this way, the inertia forces resulting from shocks and/or vibrations that could cause damages or cracks to the disc itself are avoided.

[0061] The device is advantageously mounted in a tensional pre-compression state between the respective flange and counter-flange retaining means; in this way it is possible to prevent that following the dynamic action of shocks and/or vibrations, the melting element may be subject to tensile stresses that could generate the formation of cracks. Therefore, the device is resistant to environmental stresses the container it is applied to may undergo during the life steps, either logistics or operating, that is, resistant to shocks and vibrations, as well as to high ambient temperatures.

[0062] Advantageously, the device allows maintaining the hydraulic and pneumatic seal of the explosive containment chamber so as to protect the explosive from possible risks of pollution from other substances, in ordinary logistic and operating conditions. In other words, the device ensures the sealing up to its triggering for extraordinary overheating conditions.

[0063] Moreover, the safety device according to the invention ensures quick and effective gas discharge before the limit explosive triggering temperature is reached. In fact, following the melting of the ring, the closing body can be easily ejected without any risk of sticking; in particular, the ejection of the closing body can take place by gravity and does not need the thrusting action of the gases inside the chamber. The device according to the present invention therefore operates based on temperature rather than on the internal gas pressure, with opening quickness and simplicity.

[0064] Following the removal of the closing body, the device frees an aperture having a wide section which allows releasing larger amounts of burnt gases and quickly decreasing the pressure in the containment chamber, without generating hazardous overpressures.

[0065] The device according to the present invention does not require high coupling accuracy; in fact, it does not envisage shaft-hole type couplings that could easily stick but flanged joints that are simple and inexpensive to make and assemble. In fact, the device can be removed by removable threaded connections and therefore does not require destructive sheet or welded part

cuts.

[0066] The device is therefore inexpensive to make and assemble as well as to maintain; in particular it does not need casting of metal material on site, a procedure that would imply considerable risks and that would complicate the end assembly and maintenance steps.

[0067] Moreover, the device according to the present invention can be advantageously mounted also on existing explosive containers; in fact it is sufficient to apply the device to an aperture obtained or made on a closing wall of the containment chamber.

[0068] Therefore, the device according to the present invention can be produced, installed, maintained and inspected at low cost in terms of labour, material and equipment.

Claims

1. A safety device (4) for containers (8) of explosive substances, said containers (8) comprising a hydraulically sealed seating chamber (12) for an explosive substance delimited by at least one closing wall (16), said closing wall (16) having a venting aperture (20);
the device (4) comprising at least one closing body (28) suitable for hermetically closing said venting aperture (20),

- the device comprising retain means (34, 38, 42) of the closing body (28), mechanically separate from the closing body (28), and suitable for constraining the closing body (28) on the venting aperture (20),

wherein said retain means (34, 38, 42) comprise

- a melting element (38), suitable for melting in order to release the closing body (28), in the case of overcoming of a predetermined temperature threshold below the priming temperature of the explosive, said melting element (38) in an assembled configuration interfering at least partly with the closing body (28) for preventing the extraction of the closing body (28) from the containment chamber (12),

characterised in that
the retain means (34, 38, 42) further comprise an abutment element (42) that in an assembled configuration interferes with the melting element (38) so as to lock the melting element (38) into position against the closing body (28), said melting element (38), in an assembled configuration, being preloaded in compression between the abutment element (42) and the closing body (28),
wherein the venting aperture (20) has an axial-symmetrical shape relative to an axis (X-X) and the closing body (28) has an external shape corresponding to the internal shape of said venting aperture (20),
wherein the melting element (38) has a ring shape, so that in an assembled configuration it is axial-symmetrical relative to the axis (X-X) of the aperture (20), the melting element (38), in an assembled configuration, being preloaded in compression between the abutment element (42) and the closing body (28), according to an axial direction parallel to said axis (X-X) of aperture (20).

2. Safety device (4) according to claim 1, wherein said abutment element (42) comprises a first plate (48) suitable for influencing in compression a portion of melting element (38) in contact with the closing body (28).

3. Safety device (4) according to claim 2, wherein said first plate (48) has a shape similar to the shape of the closing body (28) so as to have external overall dimensions smaller than or equal to, the overall dimensions of the closing body (28).

4. Safety device (4) according to claim 2 or 3, wherein said first plate (48) is mechanically constrained to the closing body (28) by removable constraining means.

5. Safety device (4) according to claim 4, wherein said constraining means comprise removable connections of threaded type (52).

6. Safety device (4) according to claim 4, or 5, wherein said constraining means comprise spacer bushes (56) arranged between the first plate (48) and the closing body (28).

7. Safety device (4) according to any one of claims 2 to 6, wherein a venting valve (60) is provided between the first plate (48) and the closing body (28), suitable for intercepting the gases of the containment chamber (12) and ejecting them outside said chamber (12), as a limit pressure value is exceeded.

8. Safety device (4) according to any one of the previous claims, wherein said abutment element (42) comprises a second plate (64) suitable for influencing in compression a portion of the melting element (38) in contact with a portion of said closing wall (16).

9. Safety device (4) according to claim 8, wherein said first and second plate (48, 64) are mechanically separate from each other.

10. Safety device (4) according to any one of claims 2 to 9, wherein said melting element (38) comprises at least one guiding rib (68) suitable for facilitating the positioning of the melting element (38) relative

to at least one of the closing body (28) and the first plate (48).

11. Safety device (4) according to any one of the previous claims, wherein said melting element (38) comprises a bismuth-tin alloy, having a melting point comprised between 135 °C and 145 °C.

12. Safety device (4) according to any one of the previous claims, wherein said melting element (38) comprises an eutectic bismuth-tin alloy, having a melting point equal to 138 °C.

13. Safety device (4) according to any one of claims 1 to 10, wherein said melting element (38) comprises high density polyethylene (HDPE) having a melting point equal to 135 °C.

14. Safety device (4) according to any one of the previous claims, wherein said melting element (38) is a ring having a dimensional ratio between a radial thickness and an axial thickness greater than or equal to 1.

15. Safety device (4) according to claim 11, wherein said dimensional ratio is comprised between 2 and 2.5.

16. Safety device (4) according to any one of claims 1 to 15, wherein the closing body (28) is made of aluminium.

17. Safety device (4) according to any one of claims 1 to 16, comprising sealing means (74, 76) suitable for ensuring the hydraulic seal of the containment chamber (12).

18. Safety device (4) according to claim 17, wherein said sealing means comprise at least one O-ring (76) arranged between the closing wall (16) and the closing body (28).

19. Safety device (4) according to claim 17 or 18, wherein said sealing means comprise at least one O-ring arranged between the closing body (28) and the melting element (38).

20. Safety device (4) according to any one of claims 1 to 19, comprising a flange (80) suitable for being inserted in the venting aperture (20) and for seating at least partly the closing body (28), so as to sealingly close, together with the closing body (28), the venting aperture (20).

21. Safety device (4) according to claim 20, wherein said flange (80) comprises a fixing collar (84) suitable for making an abutment against the closing wall (16) in the insertion of the flange (80) in the aperture (20) and for allowing the fixing of the flange (80) to said closing wall (16).

22. Safety device (4) according to claim 21, comprising at least one 0-ring type sealing ring (76) between said collar (84) and the closing wall (16).

23. Safety device (4) according to claim 20, 21 or 22, wherein said flange delimits a second seat (86) for seating said melting element (38).

24. Container for explosives (8) comprising a containment chamber (12) of explosive material delimited by at least one closing wall (16), said closing wall (16) having a venting aperture (20), the container (8) being **characterised in that** it comprises a safety device (4) according to any one of claims 1 to 23.

25. Method for making an explosive container (8) safe, comprising the steps of:

- making a venting aperture (20) in a closing wall (16) of the containment chamber (12) of the explosive material,
- sealingly inserting a safety device in said venting aperture (20) according to any one of claims 1 to 23.

Patentansprüche

1. Sicherheitsvorrichtung (4) für Behälter (8) mit explosiven Substanzen, wobei die Behälter (8) eine hydraulisch versiegelte Aufnahmekammer (12) für eine explosive Substanz umfassen, die durch wenigstens eine Verschlusswand (16) begrenzt ist, wobei die Verschlusswand (16) eine Lüftungsöffnung (20) hat; wobei die Vorrichtung (4) wenigstens einen Verschlusskörper (28) umfasst, der geeignet ist, um die Lüftungsöffnung (20) hermetisch zu verschließen,

- wobei die Vorrichtung Haltemittel (34, 38, 42) des Verschlusskörpers (28) umfasst, die mechanisch von dem Verschlusskörper (28) getrennt sind und geeignet sind, um den Verschlusskörper (28) auf der Lüftungsöffnung (20) fest zu halten,

wobei die Haltemittel (34, 38, 42) umfassen

- ein Schmelzelement (38), das geeignet ist, um zu schmelzen, um den Verschlusskörper (28) im Fall des Übersteigens einer vorgegebenen Temperaturschwelle unterhalb der Zündtemperatur des Explosivstoffs zu lösen, wobei das Schmelzelement (38) in einem montierten Aufbau wenigstens teilweise mit dem Verschlusskörper (28) eingreift, um die Extraktion bzw. das Herausziehen des Verschlusskörpers (28)

aus der Aufnahmekammer (12) zu verhindern,

dadurch gekennzeichnet, dass
die Haltemittel (34, 38, 42) ferner ein Anschlagelement (42) umfassen, das in einem montierten Aufbau mit dem Schmelzelement (38) eingreift, um das Schmelzelement (38) in seiner Position gegen den Verschlusskörper (28) zu arretieren, wobei das Schmelzelement (38) in einem montierten Aufbau zwischen dem Anschlagelement (42) und dem Verschlusskörper (28) komprimiert vorgespannt ist, wobei die Lüftungsöffnung (20) eine axialsymmetrische Form relativ zu einer Achse (X-X) hat und der Verschlusskörper (28) eine äußere Form hat, die der inneren Form der Lüftungsöffnung (20) entspricht,
wobei das Schmelzelement (38) eine Ringform hat, so dass sie in einem montierten Aufbau axialsymmetrisch in Bezug auf die Achse (X-X) der Öffnung (20) ist,
wobei das Schmelzelement (38) in einem montierten Aufbau zwischen dem Anschlagelement (42) und dem Verschlusskörper (28) in einer Axialrichtung parallel zu der Achse (X-X) der Öffnung (20) komprimiert vorgespannt ist.

2. Sicherheitsvorrichtung (4) nach Anspruch 1, wobei das Anschlagelement (42) eine erste Platte (48) umfasst, die geeignet ist, auf einen Abschnitt des Schmelzelements (38) in Kontakt mit dem Verschlusskörper (28) komprimierend einzuwirken.

3. Sicherheitsvorrichtung (4) nach Anspruch 2, wobei die erste Platte (48) eine Form hat, die ähnlich der Form des Verschlusskörpers (28) ist, so dass sie äußere Gesamtabmessungen hat, die kleiner oder gleich den Gesamtabmessungen des Verschlusskörpers (28) sind.

4. Sicherheitsvorrichtung (4) nach Anspruch 2 oder 3, wobei die erste Platte (48) durch entfernbare Festhaltemittel mechanisch an den Verschlusskörper (28) gefesselt ist.

5. Sicherheitsvorrichtung (4) nach Anspruch 4, wobei die Festhaltemittel entfernbare Verbindungen mit Gewinde (52) umfassen.

6. Sicherheitsvorrichtung (4) nach Anspruch 4 oder 5, wobei die Festhaltemittel Distanzbuchsen (56) umfassen, die zwischen der ersten Platte (48) und dem Verschlusskörper (28) angeordnet sind .

7. Sicherheitsvorrichtung (4) nach einem der Ansprüche 2 bis 6, wobei ein Lüftungsventil (60) zwischen der ersten Platte (48) und dem Verschlusskörper (28) bereitgestellt ist, das geeignet ist, die Gase der Aufnahmekammer (12) aufzufangen und sie nach außen auszustoßen, wenn ein Grenzdruckwert überschritten wird.

8. Sicherheitsvorrichtung (4) nach einem der vorhergehenden Ansprüche, wobei das Anschlagelement (42) eine zweite Platte (64) umfasst, die geeignet ist, um auf einen Abschnitt des Schmelzelements (38) in Kontakt mit einem Abschnitt der Verschlusswand (16) komprimierend einzuwirken.

9. Sicherheitsvorrichtung (4) nach Anspruch 8, wobei die erste und zweite Platte (48, 64) mechanisch voneinander getrennt sind.

10. Sicherheitsvorrichtung (4) nach einem der Ansprüche 2 bis 9, wobei das Schmelzelement (38) wenigstens eine Führungsrippe (68) umfasst, die geeignet ist, um die Positionierung des Schmelzelements (38) in Bezug auf wenigstens den Verschlusskörper (28) oder die erste Platte (48) zu erleichtern.

11. Sicherheitsvorrichtung (4) nach einem der vorhergehenden Ansprüche, wobei das Schmelzelement (38) eine Wismut-Zinn-Legierung umfasst, die einen Schmelzpunkt zwischen 135°C und 145°C hat.

12. Sicherheitsvorrichtung (4) nach einem der vorhergehenden Ansprüche, wobei das Schmelzelement (38) eine eutektische Wismut-Zinn-Legierung mit einem Schmelzpunkt gleich 138°C ist.

13. Sicherheitsvorrichtung (4) nach einem der Ansprüche 1 bis 10, wobei das Schmelzelement (38) ein hochdichtes Polyethylen (HDPE) mit einem Schmelzpunkt gleich 135°C umfasst.

14. Sicherheitsvorrichtung (4) nach einem der vorhergehenden Ansprüche, wobei das Schmelzelement (38) ein Ring mit einem Abmessungsverhältnis zwischen einer radialen Dicke und einer axialen Dicke größer oder gleich 1 ist.

15. Sicherheitsvorrichtung (4) nach Anspruch 11, wobei das Abmessungsverhältnis zwischen 2 und 2,5 liegt.

16. Sicherheitsvorrichtung (4) nach einem der Ansprüche 1 bis 15, wobei der Verschlusskörper (28) aus Aluminium gefertigt ist.

17. Sicherheitsvorrichtung (4) nach einem der Ansprüche 1 bis 16, die Versiegelungsmittel (74, 76) umfasst, die geeignet sind, um die hydraulische Versiegelung der Aufnahmekammer (12) sicherzustellen.

18. Sicherheitsvorrichtung (4) nach Anspruch 17, wobei die Versiegelungsmittel wenigstens einen O-Ring (76) umfassen, der zwischen der Verschlusswand (16) und dem Verschlusskörper (28) angeordnet ist.

19. Sicherheitsvorrichtung (4) nach Anspruch 17 oder 18, wobei die Versiegelungsmittel wenigstens einen O-Ring umfassen, der zwischen dem Verschlusskörper (28) und dem Schmelzelement (38) angeordnet ist.

20. Sicherheitsvorrichtung (4) nach einem der Ansprüche 1 bis 19, die einen Flansch (80) umfasst, der geeignet ist, in die Lüftungsöffnung (20) eingesetzt zu werden und um zumindest teilweise den Verschlusskörper (28) aufzunehmen, um die Lüftungsöffnung (20) zusammen mit dem Verschlusskörper (28) versiegelnd zu verschließen.

21. Sicherheitsvorrichtung (4) nach Anspruch 20, wobei der Flansch (80) eine Befestigungsmanschette (84) hat, die geeignet ist, beim Einsetzen des Flansches (80) in die Öffnung (20) gegen die Verschlusswand (16) anzuliegen und um die Befestigung des Flansches (80) an der Verschlusswand (16) zu erlauben.

22. Sicherheitsvorrichtung (4) nach Anspruch 21, die wenigstens einen Dichtungsring (76) vom O-Ringtyp zwischen der Manschette (84) und der Verschlusswand (16) hat.

23. Sicherheitsvorrichtung (4) nach Anspruch 20, 21 oder 22, wobei der Flansch eine zweite Aufnahme (86) zum Aufnehmen des Schmelzelements (38) begrenzt.

24. Behälter für Explosivstoffe (8), der eine Aufnahmekammer (12) für explosives Material umfasst, die durch wenigstens eine Verschlusswand (16) begrenzt ist, wobei die Verschlusswand (16) eine Lüftungsöffnung (20) hat, wobei der Behälter (8) **dadurch gekennzeichnet ist, dass** er eine Sicherheitsvorrichtung (4) nach einem der Ansprüche 1 bis 23 umfasst.

25. Verfahren, um einen explosiven Behälter sicher zu machen, das die folgenden Schritte umfasst:

- Herstellen einer Lüftungsöffnung (20) in einer Verschlusswand (16) der Aufnahmekammer (12) für das explosive Material,
- versiegelndes Einsetzen einer Sicherheitsvorrichtung in die Lüftungsöffnung (20) nach einem der Ansprüche 1 bis 23.

Revendications

1. Dispositif de sécurité (4) pour conteneurs (8) de substances explosives, lesdits conteneurs (8) comprenant une chambre de logement scellée par voie hydraulique (12) pour une substance explosive délimitée par au moins une paroi de fermeture (16), ladite paroi de fermeture (16) ayant une ouverture d'aération (20);

- le dispositif (4) comprenant au moins un corps de fermeture (28) approprié pour fermer hermétiquement ladite ouverture d'aération (20),
- le dispositif comprenant des moyens de retenue (34, 38, 42) du corps de fermeture (28), séparés mécaniquement du corps de fermeture (28), et convenant pour presser le corps de fermeture (28) sur l'ouverture d'aération (20), dans lequel lesdits moyens de retenue (34, 38, 42) comprennent :
- un élément de fusion (38), convenant à une fusion pour libérer le corps de fermeture (28), dans le cas de dépassement d'un seuil de température prédéterminé en dessous de la température d'amorçage de l'explosif, ledit élément de fusion (38) en configuration assemblée interférant au moins en partie avec le corps de fermeture (28) pour empêcher l'extraction du corps de fermeture (28) de la chambre de confinement (12),

caractérisé en ce que

les moyens de retenue (34, 38, 42) comprennent en outre un élément de butée (42) qui, en configuration assemblée, interfère avec l'élément de fusion (38) de manière à verrouiller l'élément de fusion (38) en position contre le corps de fermeture (28), ledit élément de fusion (38), en configuration assemblée, étant préchargé à la compression entre l'élément de butée (42) et le corps de fermeture (28),

dans lequel l'ouverture d'aération (20) a une forme axialement symétrique par rapport à un axe (X-X) et le corps de fermeture (28) a une forme externe correspondant à la forme interne de ladite ouverture d'aération (20), dans lequel l'élément de fusion (38) a une forme annulaire, de sorte que, en configuration assemblée, il soit axialement symétrique par rapport à l'axe (X-X) de l'ouverture (20),

l'élément de fusion (38), en configuration assemblée, étant préchargé à la compression entre l'élément de butée (42) et le corps de fermeture (28), selon une direction axiale parallèle audit axe (X-X) de l'ouverture (20).

2. Dispositif de sécurité (4) selon la revendication 1, dans lequel ledit élément de butée (42) comprend une première plaque (48) appropriée pour influencer en compression une partie de l'élément de fusion (38) en contact avec le corps de fermeture (28).

3. Dispositif de sécurité (4) selon la revendication 2, dans lequel ladite première plaque (48) a une forme similaire à la forme du corps de fermeture (28) de manière à avoir des dimensions globales externes

inférieures ou égales aux dimensions globales du corps de fermeture (28).

4. Dispositif de sécurité (4) selon la revendication 2 ou 3, dans lequel ladite première plaque (48) est mécaniquement pressée sur le corps de fermeture (28) par des moyens de contrainte amovibles.

5. Dispositif de sécurité (4) selon la revendication 4, dans lequel lesdits moyens de contrainte comprennent des raccordements amovibles de type fileté (52).

6. Dispositif de sécurité (4) selon la revendication 4, ou 5, dans lequel lesdits moyens de contrainte comprennent des douilles d'espacement (56) aménagées entre la première plaque (48) et le corps de fermeture (28).

7. Dispositif de sécurité (4) selon l'une quelconque des revendications 2 à 6, dans lequel une soupape d'aération (60) est aménagée entre la première plaque (48) et le corps de fermeture (28), appropriée pour intercepter les gaz de la chambre de confinement (12) et les éjecter de ladite chambre (12) lorsqu'une valeur de pression limite est dépassée.

8. Dispositif de sécurité (4) selon l'une quelconque des revendications précédentes, dans lequel ledit élément de butée (42) comprend une seconde plaque (64) appropriée pour influencer en compression une partie de l'élément de fusion (38) en contact avec une partie de ladite paroi de fermeture (16)

9. Dispositif de sécurité (4) selon la revendication 8, dans lequel lesdites première et seconde plaques (48, 64) sont séparées mécaniquement l'une de l'autre.

10. Dispositif de sécurité (4) selon l'une quelconque des revendications 2 à 9, dans lequel ledit élément de fusion (38) comprend au moins une nervure de guidage (68) appropriée pour faciliter le positionnement de l'élément de fusion (38) par rapport au moins au corps de fermeture (28) ou à la première plaque (48).

11. Dispositif de sécurité (4) selon l'une quelconque des revendications précédentes, dans lequel ledit élément de fusion (38) comprend un alliage bismuth-étain, ayant un point de fusion compris entre 135 °C et 145 °C.

12. Dispositif de sécurité (4) selon l'une quelconque des revendications précédentes, dans lequel ledit élément de fusion (38) comprend un alliage eutectique bismuth-étain, ayant un point de fusion égal à 138 °C.

13. Dispositif de sécurité (4) selon l'une quelconque des revendications 1 à 10, dans lequel ledit élément de fusion (38) comprend un polyéthylène de haute densité (HDPE) ayant un point de fusion égal à 135 °C.

14. Dispositif de sécurité (4) selon l'une quelconque des revendications précédentes, dans lequel ledit élément de fusion (38) est un anneau ayant un rapport dimensionnel entre une épaisseur radiale et une épaisseur axiale supérieure ou égale à 1.

15. Dispositif de sécurité (4) selon la revendication 11, dans lequel ledit rapport dimensionnel est compris entre 2 et 2,5.

16. Dispositif de sécurité (4) selon l'une quelconque des revendications 1 à 15, dans lequel le corps de fermeture (28) est fabriqué en aluminium.

17. Dispositif de sécurité (4) selon l'une quelconque des revendications 1 à 16, comprenant des moyens de scellage (74, 76) appropriés pour assurer l'étanchéité hydraulique de la chambre de confinement (12).

18. Dispositif de sécurité (4) selon la revendication 17, dans lequel lesdits moyens de scellage comprennent au moins un joint torique (76) aménagé entre la paroi de fermeture (16) et le corps de fermeture (28).

19. Dispositif de sécurité (4) selon la revendication 17 ou 18, dans lequel lesdits moyens de scellage comprennent au moins un joint torique aménagé entre le corps de fermeture (28) et l'élément de fusion (38).

20. Dispositif de sécurité (4) selon l'une quelconque des revendications 1 à 19, comprenant une bride (80) appropriée pour être insérée dans l'ouverture d'aération (20) et pour loger au moins en partie le corps de fermeture (28), de manière à fermer de façon étanche, conjointement avec le corps de fermeture (28), l'ouverture d'aération (20).

21. Dispositif de sécurité (4) selon la revendication 20, dans lequel ladite bride (80) comprend un collier de fixation (84) approprié pour presser une butée contre la paroi de fermeture (16) dans l'insertion de la bride (80) dans l'ouverture (20) et pour permettre la fixation de ladite bride (80) à ladite paroi de fermeture (16).

22. Dispositif de sécurité (4) selon la revendication 21, comprenant au moins un joint d'étanchéité de type torique (76) entre ledit collier (84) et la paroi de fermeture (16).

23. Dispositif de sécurité (4) selon la revendication 20, 21 ou 22, dans lequel ladite bride délimite un second

siège (86) pour loger ledit élément de fusion (38).

24. Conteneur pour explosifs (8) comprenant une chambre de confinement (12) de matériau explosif délimitée par au moins une paroi de fermeture (16), ladite paroi de fermeture (16) ayant une ouverture d'aération (20), le conteneur (8) étant **caractérisé en ce qu'**il comprend un dispositif de sécurité (4) selon l'une quelconque des revendications 1 à 23.

25. Procédé de sécurisation d'un conteneur d'explosifs (8), comprenant les étapes consistant à :

- réaliser une ouverture d'aération (20) dans une paroi de fermeture (16) de la chambre de confinement (12) du matériau explosif,
- insérer de manière étanche un dispositif de sécurité dans ladite ouverture d'aération (20) selon l'une quelconque des revendications 1 à 23.

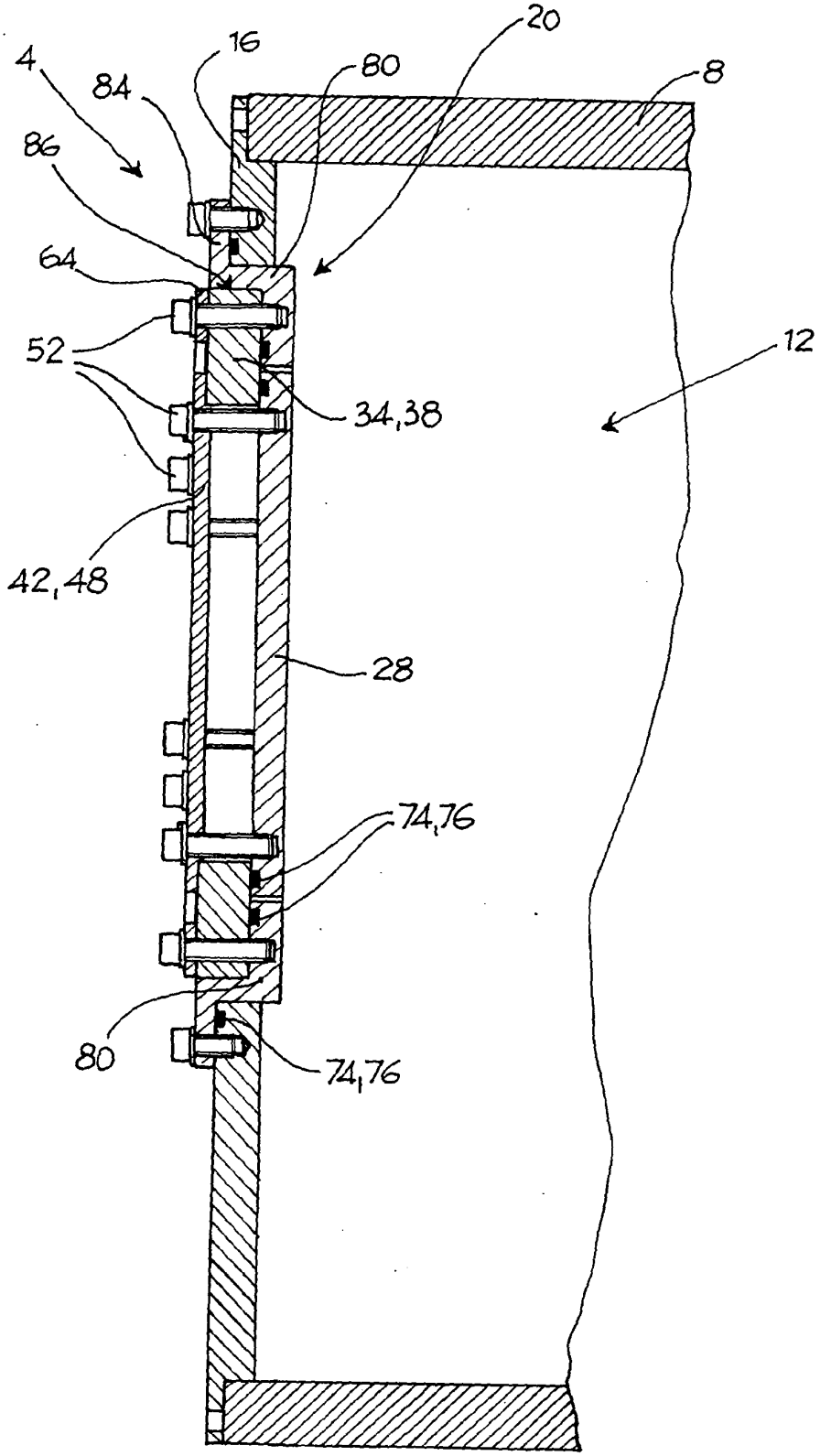
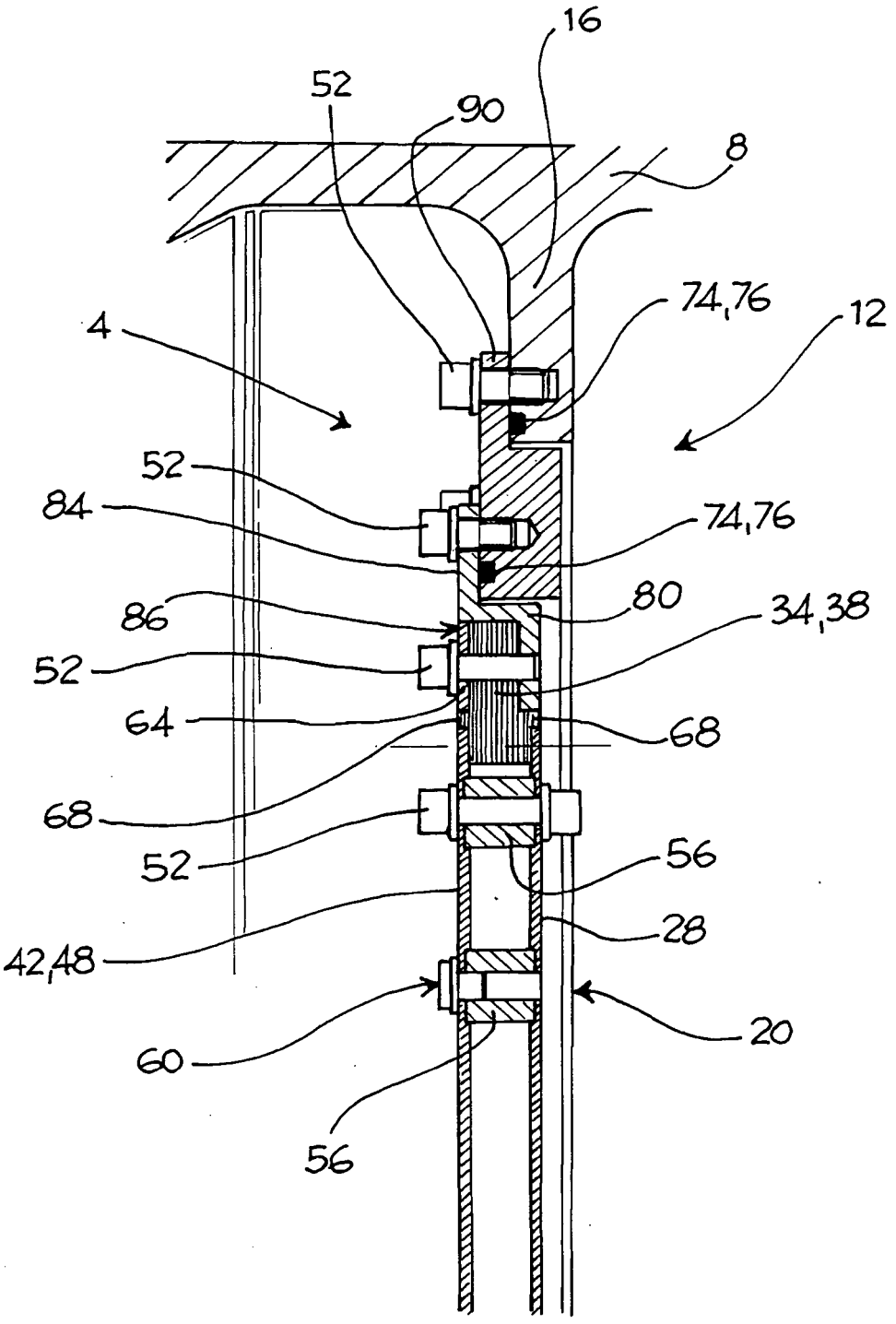


Fig.1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60
56

Fig. 2

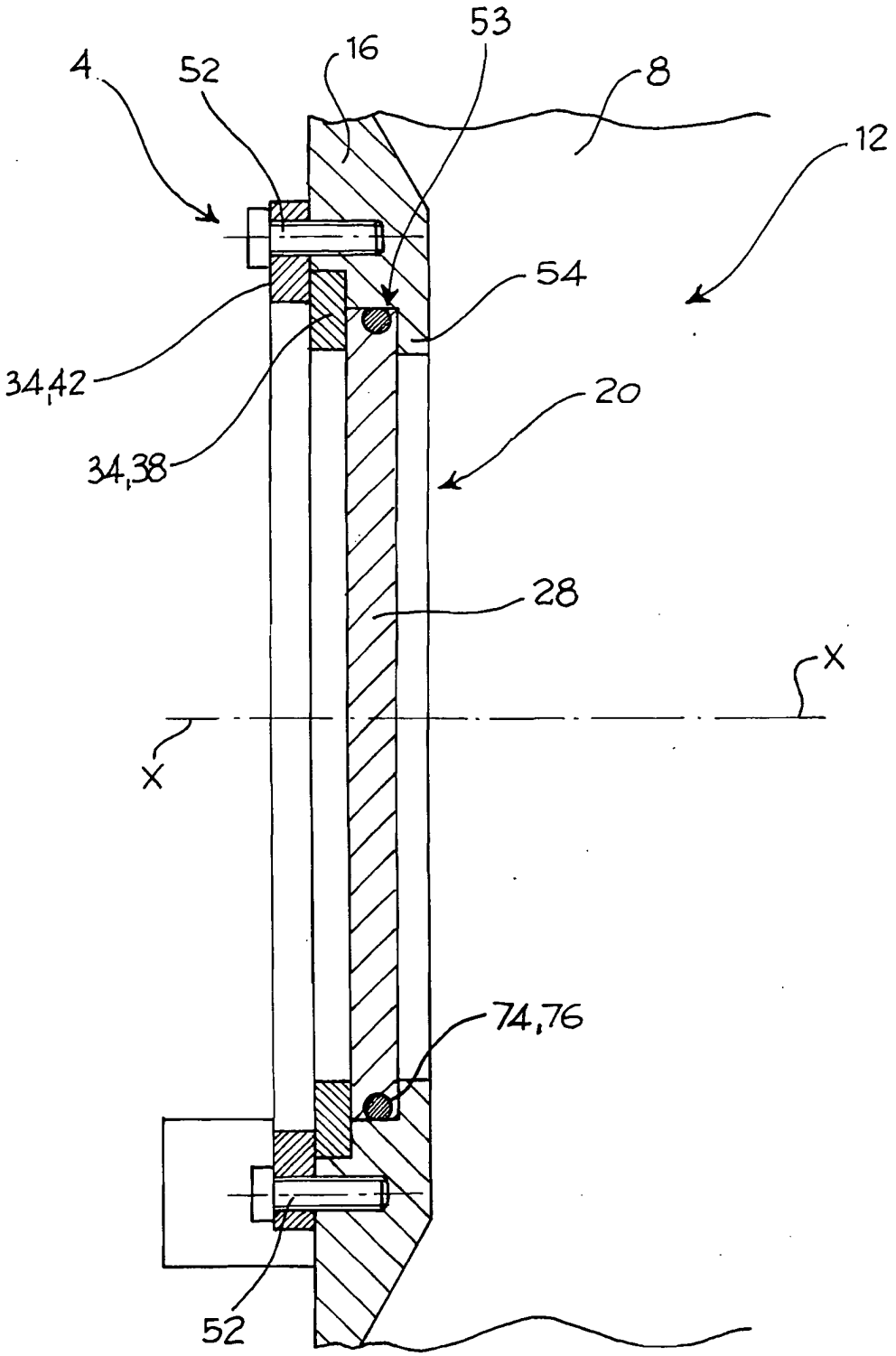

Fig.3

REFERENCES CITED IN THE DESCRIPTION

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