Claims

1. A leak detection device (54) for detecting a leak in a test zone (62) of a sealing membrane (5, 8) of a sealed and thermally insulating tank, the leak detection device (54) including:

- a leak detection dome (55) including a main body (100) intended to be disposed ~~in~~ on the test zone (62) and a seal (60) connected to the main body (100) and configured to define a detection chamber (61) between the main body (100) and the test zone (62), the seal (60) including a peripheral sealing lip (64) configured to come into contact with the sealing membrane and having a closed contour encircling the detection chamber (61),
- a vacuum pump (57) connected to the detection chamber (61) to generate a reduced pressure in the detection chamber (61), and
- an analysis tool (56) connected to the detection chamber (61) to analyze a gas present in the detection chamber (61),

in which the sealing lip (64) is configured to occupy two positions, namely a first position in an initial state, without application of a vacuum in the detection chamber (61), and a second position in a service state, with application of a vacuum in the detection chamber (61) to perform a depression in the detection chamber (61), the sealing lip (64) comprising only in the second position relative to the service state a pinch portion (53) that is pinched between the main body (100) and the sealing membrane (5, 8) over at least a part of the periphery of the detection chamber (61), the sealing lip (64) having a flexibility allowing the formation of said pinch portion (53) by deformation of the sealing lip (64) towards the detection chamber (61) under the effect of the depression in the detection chamber (61).

2. The device as claimed in claim 1, in which the sealing lip (64) is configured to have, at least in a service state in which a reduced pressure is applied in the detection chamber (61), a pinch portion (53) that is pinched between the main body (100) and the sealing membrane (5, 8) over all of the periphery of the detection chamber (61).

3. The device as claimed in ~~any one of~~ claim~~s~~ 1 ~~to 2~~, in which the detection chamber (61) of the leak detection dome (55) has a convex zone (25)~~, for example circular or polygonal, zone (25)~~ intended to cover a junction zone between four corrugated or plane metal plates (31).

4. The device as claimed in claim 3, in which the convex zone (25) ~~a circle geometrically inscribed in the convex zone (25)~~ has a diameter greater than 68 mm, the diameter of the convex zone (25) being defined by a circle geometrically inscribed in the convex zone (25).

5. The device as claimed in claim 3 ~~or 4~~, in which the detection dome has an elongate shape along a longitudinal axis, the detection chamber (61) of the leak detection dome (55) including an elongate zone (24) intended to cover a rectilinear edge of a metal plate, the convex zone (25) being disposed at one end of the elongate zone.

6. The device as claimed in claim 5, in which the convex zone is a first convex zone (25) and the detection chamber (61) of the leak detection dome (55) includes a second convex zone disposed at an end of the elongate zone opposite the first convex zone (25) along the longitudinal axis.

7. The device as claimed in claim 3 ~~or 4~~, in which the detection dome has an elongate shape along a longitudinal axis, the convex zone (25) constituting a central portion of the detection chamber (61) of the leak detection dome (55), the detection chamber (61)

including two elongate zones (24) extending from the convex zone away from one another along the longitudinal axis.

8. The device as claimed in claim 3, in which the detection chamber (61) has a convex polygonal or circular cross-sectional shape.

9. The device as claimed in claim 8, in which ~~a circle geometrically inscribed in the shape of the detection chamber~~ the shape of the detection chamber has a diameter greater than 68 mm, the diameter of the shape of the detection chamber being defined by a circle geometrically inscribed in the shape of the detection chamber.

10. The device as claimed in ~~any one of~~ claim~~s~~ 1 ~~to 9~~, in which the leak detection dome (55) includes a mechanical pressure means (66) carried by the main body (100) and including at least one pressure element (72) configured to exert on a portion of the sealing lip (64) a pressure directed toward the membrane (5, 8) when the main body (100) is disposed in the test zone (62).

11. The device as claimed in ~~any one of~~ claim~~s~~ 1 ~~to 10~~, in which the analysis tool (56) is configured to detect a tracer gas.

12. The device as claimed in ~~any one of~~ claim~~s~~ 1 ~~to 10~~, in which the analysis tool (56) is configured to detect a component of the surrounding air.

13. A method of using a leak detection device (54) as claimed in ~~any one of~~ claim~~s~~ 3 ~~to 12~~ in a test zone (62) including a junction zone between four corrugated or plane metal plates (31) of a tank sealing membrane (5, 8), the method including the steps of:
- placing the leak detection dome (55) in the test zone (62) in such a manner that the sealing lip (64) comes into contact with the sealing membrane all around the test zone (62) and the convex zone (25) covers said junction zone,
- generating a reduced pressure in the detection chamber (61) by means of the vacuum pump (57),
- pinching the pinch portion of the sealing lip (64) between the main body (100) and the sealing membrane (5, 8) over at least a part of the periphery of the detection chamber (61),
- conveying the gases present in the detection chamber (61) toward the analysis tool (56), and
- analyzing by means of the analysis tool (56) the gases coming from the detection chamber (61) to produce a measurement signal representing a quantity of at least one gas present in the detection chamber (61).

14. A leak detection method for detecting a leak in a test zone of a sealing membrane of a tank with the aid of a leak detection dome,
the leak detection dome including a main body and a seal connected to the main body and configured to define a detection chamber between the main body and the sealing membrane, the seal including a peripheral sealing lip configured to come into contact with the sealing membrane and having a closed contour encircling the detection chamber, the leak detection dome further including a mechanical pressure means carried by the main body and including at least one pressure element configured to exert on a portion of the sealing lip a pressure directed toward the membrane when the main body is disposed in the test zone,
the detection dome comprising a support element (73) fixed to the main body (100), the pressure element comprising a body (89) fixed to the support element (73), a rod (90) mounted to be mobile in translation relative to the body (89), a spring (86) urging the rod (90) towards the sealing lip (64) and a bearing element (91) fixed to one end of the rod (90) and coming to bear against the sealing lip (64) under the effect of the spring (86)~~.~~,
said sealing membrane including a plurality of corrugated or plane metal plates that are welded

to one another,
the leak detection method including the following steps ~~consisting in~~:
- disposing the detection dome against the sealing membrane so as to position the detection chamber in line with at least one weld bead between a first metal plate and a second metal plate and positioning the pressure element to exert the pressure on a portion of the sealing lip that crosses said weld bead,
- reducing the pressure in the detection chamber by means of a vacuum pump,
- conveying the gas phase contained in the detection chamber to an analysis tool to detect a gas present in the detection chamber.

15. The method as claimed in claim 14, in which the detection chamber (61) of the leak detection dome (55) includes a convex zone (25), said pressure element for exerting the pressure on the portion of the sealing lip that crosses said weld bead being disposed at the periphery of the convex zone (25).

16. The method as claimed in claim 15, in which the weld bead between the first metal plate and the second metal plate is a first weld bead and the pressure element is a first pressure element, and in which the convex zone (25) of the detection chamber is also placed in line with a second weld bead joining the first or second metal plate (31) with a third metal plate, the mechanical pressure means further including a second pressure element positioned to exert the pressure on a portion of the sealing lip that crosses said second weld bead.

17. The method as claimed in claim 16, in which the metal plates are substantially rectangular and the detection chamber is placed in line with a junction zone between the first, second, third metal plates and a fourth metal plate, the junction zone further including a third weld bead joining the first or second metal plate (31) with the fourth metal plate, the mechanical pressure means further including a third pressure element positioned to exert the pressure on a portion of the sealing lip that crosses said third weld bead.

18. The method as claimed in ~~any one of~~ claim~~s 14 to 17~~15, in which the detection dome has an elongate shape along a longitudinal axis, the detection chamber (61) of the leak detection dome (55) including an elongate zone (24) intended to cover a rectilinear edge of a metal plate, the convex zone (25) being disposed at one end of the elongate zone.

19. The method as claimed in ~~any one of~~ claim~~s~~ 14 ~~to 18~~, in which the rod is a first rod (90), and the pressure element includes a second rod (90) mounted to be mobile in translation relative to the main body (100), the first rod and the second rod (90) being at a distance from one another, springs (86) urging said rods (90) toward the sealing lip (64), and the bearing element being an elongate bearing element (91) having a first end fixed to one end of the first rod (90) and a second end fixed to one end of the second rod (90), said elongate bearing element (91) coming to bear against the sealing lip (64) because of the effect of the springs.

20. The method as claimed in ~~any one of~~ claim~~s~~ 14 ~~to 19~~, in which the pressure element (87) includes a plurality of adjustment elements (92) mounted on the main body (100) and forming a line, an adjustment element (92) including ~~a~~ an adjustment rod (93) extending perpendicularly in the direction of the sealing lip (64), the adjustment rod (93) having an end (94) the position of which is adjustable in a longitudinal direction of the rod so as to come into contact with the sealing lip.

21. The method as claimed in claim 20, in which the pressure element (87) further includes a distribution sole plate (95) arranged between the ends (94) of the adjustment rods (93) and the sealing lip (64).