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(54) FIRE SUPPRESSANT APPARATUS

(57) There is provided an apparatus comprising:
a container 100 for holding a fire suppressant;
a valve 200 sealing said container 100 and comprising a diaphragm 130 configured to perforate so as to release pressurised fire suppressant from said container 100;
a pyrotechnic charge 140 for perforating said diaphragm 130;
a barrier 150 configured to prevent contact of fire suppressant with said diaphragm 130 prior to perforation of said diaphragm 130, and to allow fire suppressant to be released from said container 100 after perforation of said diaphragm 130.

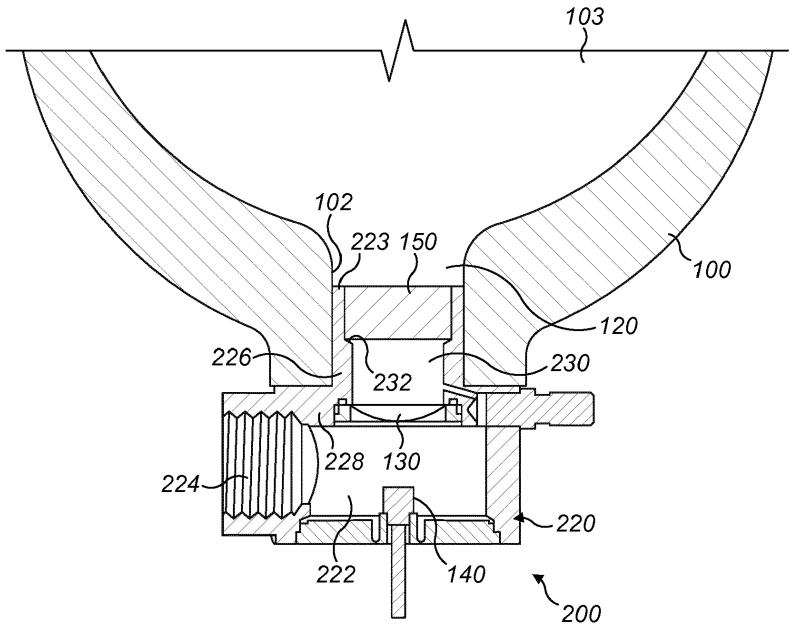


FIG. 2

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Description

[0001] The present disclosure generally relates to an apparatus comprising a container for holding fire suppressant, and a valve for sealing a container holding a fire suppressant powder.

BACKGROUND

[0002] Fire suppressant, in particular powder fire suppressant, is typically held in a pressurised container until such time that it is required to be deployed into an environment. A valve may be placed at an outlet of the container to prevent premature deployment of the suppressant, which valve may be activated by use of a pyrotechnic charge as discussed below. An example of such a container and valve arrangement is shown in Figs. 1A-1C.

[0003] Fig. 1A shows a container 10 for holding a fire suppressant at a raised pressure, and a valve 20 for controlling the release of the fire suppressant into an environment (not shown).

[0004] Fig. 1 B shows a cross-section of the container 10 and valve 20 through line A-A in Fig. 1. The operative orientation of the container is such that the valve 20 is located at the bottom of the container in use. Thus, it can be seen that in operation the fire suppressant 1 is held within the container and rests on the valve 20 due to gravity.

[0005] Fig. 1C shows a close up of the valve 20 (indicated at "B" in Fig. 1 B), which comprises a hollow valve body 22 that is located inside an outlet 12 of the container 10. A rupturable diaphragm 30 is located within the valve body 22 and acts to seal the container 10 to prevent pressurised fire suppressant from escaping prematurely.

[0006] A pyrotechnic charge 40 is located inside the valve 20 and below the diaphragm 30. Upon actuation of the pyrotechnic charge 40 a shockwave or localised blast is directed onto the centre of the diaphragm 30. This shockwave causes flexure of the diaphragm 30 inwards towards the fire suppressant 1. This causes mechanical weakening of the diaphragm 30 causing the diaphragm 30 to rupture or perforate (e.g. burst open, tear) and open outwards away from the fire suppressant 1.

[0007] Once the diaphragm 30 is perforated a pressure differential is created between the interior of the container 10 and the external environment. This causes the fire suppressant to expel out through the outlet 12 and valve 20 and into the environment to perform its fire suppressing function.

[0008] The present disclosure is aimed improving the ability of the diaphragm to open to ensure that the fire suppressant can be deployed.

SUMMARY

[0009] According to an aspect of the disclosure, there is provided an apparatus comprising:

a container for holding a fire suppressant;

a valve sealing the container and comprising a diaphragm configured to perforate so as to release fire suppressant from the container;

a pyrotechnic charge for perforating the diaphragm;

a barrier configured to prevent contact of fire suppressant with the diaphragm prior to perforation of the diaphragm, and to allow fire suppressant to be released from the container after perforation of the diaphragm.

[0010] The apparatus may comprise a fire suppressant powder held within the container.

[0011] The barrier may be a layer of gas-permeable material that sits on a portion of the valve extending into the container, and may extend across an outlet of the container to prevent contact of fire suppressant with the diaphragm in use.

[0012] The barrier may be spaced from the diaphragm such that an air gap is present between the barrier and the diaphragm.

[0013] The barrier may be configured to substantially prevent fire suppressant powder from entering the air gap prior to perforation of the diaphragm.

[0014] The barrier may be configured to deform upon perforation of the diaphragm to allow fire suppressant to be released from the container.

[0015] The barrier may be configured to substantially prevent fire suppressant powder from acting on the diaphragm due to gravity.

[0016] The barrier may be gas-permeable, for example a layer of gas-permeable foam.

[0017] The container and/or fire suppressant powder may be pressurised.

[0018] The apparatus may further comprise means for creating a pressure differential across the diaphragm and/or barrier upon or after perforation of the diaphragm. The means may be the pressurisation of the container.

[0019] The diaphragm may comprise a metal disc, and the metal disc may be hemispherical. The diaphragm may comprise lines of weakness to aid perforation thereof by the pyrotechnic charge. The diaphragm may be of the "non-fragmenting" type, in that it may be configured to flex, weaken and perforate, due to the directed shockwave. The diaphragm may comprise portions that are configured to open along the lines of weakness, for example petals. The diaphragm and/or lines of weakness and/or portions of the diaphragm may be configured to open towards the pyrotechnic charge. The diaphragm is optionally configured to perforate or open as described above due to the combined effect of the combustion products of the pyrotechnic charge, as well as the storage pressure of the fire suppressant.

[0020] According to an aspect of the disclosure, there is provided a method comprising:

loading fire suppressant into a container;

pressurising the container;

sealing the container with a valve, wherein the valve comprises a diaphragm configured to perforate so as to release pressurised fire suppressant from the container; and

providing a temporary barrier between the diaphragm and the fire suppressant, wherein the barrier is configured to prevent contact of the fire suppressant with the diaphragm prior to perforation of the diaphragm, and to allow fire suppressant to be released from the container after perforation of the diaphragm.

[0021] The method may further comprise perforating the diaphragm using a pyrotechnic charge so as to cause the pressurised fire suppressant to be released from the container.

[0022] The step of perforating the diaphragm may create a pressure differential across the barrier, for example due to the pressurising of the container, that forces the barrier through the ruptured diaphragm and allows fire suppressant to be released from the container.

[0023] According to an aspect of the disclosure, there is provided a valve for sealing a container holding a fire suppressant powder, the valve comprising:

a passage extending between a valve inlet and a valve outlet, wherein in use fire suppressant flows into the valve inlet from the container, and then through the passage to the valve outlet;

a diaphragm within the passage and a pyrotechnic charge adjacent to the diaphragm;

wherein the diaphragm is configured to initially prevent flow of fire suppressant through the passage, and to perforate upon activation of the pyrotechnic charge so as to allow flow of fire suppressant through the passage;

a temporary barrier located at the valve inlet, wherein the barrier is configured to provide an air gap between the barrier and the diaphragm prior to perforation of the diaphragm, and to allow fire suppressant to enter the passage after perforation of the diaphragm.

[0024] The barrier may be a layer of gas-permeable material.

[0025] The barrier may be configured to deform upon perforation of the diaphragm to allow fire suppressant to be released from the container.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Various embodiments will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figs. 1A-1C show a conventional container for holding fire suppressant; and

Fig. 2 shows a container for holding fire suppressant in accordance with the present disclosure.

DETAILED DESCRIPTION

[0027] An embodiment of the present disclosure will now be described with reference to Fig. 2, which shows an apparatus including a container 100 and a valve 200.

[0028] The container 100 is of the type used to hold a fire suppressant (not shown) in its interior, optionally in powder form, and is largely cylindrical, forming a bottle-shape with an outlet 120 provided at a lower end of the container 100. The container 100 comprises a neck portion 102 and a chamber portion 103. The chamber portion 103 has a maximum diameter that is relatively large when compared to the diameter of the neck portion 102, and forms the main body of the container 100 for holding most of the fire suppressant. The neck portion 102 and the outlet 120 are of a smaller diameter.

[0029] The interior of the container is pressurised, for example using nitrogen gas. The valve 200 is inserted into the outlet 120 so as to plug or seal the container 100 and prevent pressurised fire suppressant held within the container from being released prematurely. Other shapes of container may be used, and the disclosure is not limited to cylindrical containers such as the one shown.

[0030] The valve 200 comprises a valve body 220 that is hollow and forms a passage 222 for fire suppressant to transfer from the interior of the container 100 to the environment. The passage 222 extends from a valve inlet 223 to a valve outlet 224. The valve inlet 223 and a neck 226 of the valve body 220 fit within the outlet 120 of the container 100, and a shoulder portion 228 of the valve body 220 rests on an exterior surface of the container 100. The valve inlet 223 and neck 226 are sealed against the walls of the neck portion 102 and outlet 120 of the container 100. Any suitable sealing method may be used.

[0031] The apparatus includes a rupturable diaphragm 130 that is positioned within the passage 222 of the valve body 220. The diaphragm 130 is sealed against the interior walls of the passage 222 and valve body 220 so as to prevent the fire suppressant from being released through said passage 222.

[0032] A pyrotechnic charge 140 is provided and arranged such that, upon activation of the charge, a percussive shockwave is directed onto the diaphragm 130 by the rapid release of gas and heat generated by the pyrotechnic charge 140. This causes the diaphragm 130 to flex, weaken and perforate (or burst, fail, tear etc). Due in part to the pressure differential across the diaphragm when the container 100 is pressurised, the diaphragm perforates outwards away from the chamber portion 103 and fire suppressant.

[0033] This mechanism is different from, say, an explosive charge that uses fragments of hot metal to perforate the diaphragm, although such a charge is not excluded from the broadest aspects of this disclosure.

[0034] After perforation of the diaphragm 130, fire sup-

pressant transfers from the interior of the container 100 to the environment via passage 222. This is due, in part, to the fire suppressant being held under pressure within the container 100. That is, rupturing the diaphragm 130 results in a pressure differential between the interior of the container 100 and the passage 222 or external environment.

[0035] It has been recognised that the weight of fire suppressant acting on the diaphragm in conventional arrangements (see Figs. 1A-1 C) can prevent the proper opening of the diaphragm upon activation of the pyrotechnic charge. The weight of the fire suppressant, for example a fire suppressant powder, resting on a diaphragm may act as a mechanical damper and absorb some of the energy delivered by the pyrotechnic charge that would otherwise act to rupture the diaphragm. The fire suppressant may also act as a thermal damper, absorbing some of the heat released from the charge.

[0036] In accordance with the disclosure, a means is provided to prevent contact of the fire suppressant with the diaphragm 130 in use. This eliminates the damping effect of the fire suppressant and improves the ability of the diaphragm 130 to perforate upon activation of the pyrotechnic charge 140. The means is also configured to allow fire suppressant to be released from said container 100 into an external environment once the diaphragm is ruptured.

[0037] In the embodiment of Fig. 2, a barrier 150 is located above the diaphragm such that an air gap 230 is formed between the diaphragm 130 and the barrier 150. The fire suppressant (not shown) sits or rests on the barrier 150 in use, and is prevented from contacting the diaphragm 130 by the barrier 150. The barrier 150 optionally has sufficient strength to support the weight of the fire suppressant as required.

[0038] The barrier 150 may comprise a layer or disc of gas-permeable material, for example an aerated foam, and is optionally held in place upon a lip or ledge 232 of the valve body 220 that is located at the end of the air gap 230 towards the interior of the container 100. The weight of the fire suppressant optionally pushes the barrier 150 against the lip or ledge 232, which prevents the barrier 150 from moving towards the diaphragm 130 prior to its rupturing.

[0039] The diaphragm 130 is typically made of metal, for example stainless steel or nickel. The diaphragm 130 may be scored across its surface to promote failure of the diaphragm 130 along predefined score lines. The score lines may form a star pattern on the surface of the diaphragm 130, causing the diaphragm 130 to petal open along the predefined score lines. As shown in Fig. 2, the diaphragm 130 is hemispherical and the tip of the hemisphere points towards the pyrotechnic charge 140, and away from the container 100 of chamber portion 103.

[0040] As stated above the barrier 150 may be gas-permeable. In this case when the diaphragm 130 is closed the gas-permeable nature of the barrier 150 optionally ensures that slow changes in gas pressures either side of the barrier 150 do not result in a significant pressure differential. Such changes in pressure may occur due to thermal expansion of the pressurising gas in the interior of the container 100.

[0041] Upon activation of the pyrotechnic charge 140, the diaphragm 130 is caused to rupture as described above, at which point a large pressure differential is created across the barrier 150. The pressure differential is large enough such that the barrier 150 is optionally forced (e.g. pushed or sucked) through the ruptured diaphragm 130 to allow the fire suppressant to escape through passage 222 into the environment via valve outlet 224.

[0042] The barrier 150 is configured such that, upon perforation of the diaphargm 130 fire suppressant can be released from the container 100. For example, the barrier 150 may be deformable or moveable such that the pressure differential created upon perforation of the diaphragm 130 causes the barrier 150 to deform or move, so as to allow fire suppressant to pass from the container 100, through the passage 222 and out to an external environment.

[0043] The barrier 150 may be made of a deformable material, such as a gas-permeable layer, for example a layer of gas-permeable foam. When a pressure differential is created across the barrier 150 due to ruptured diaphragm 140, the barrier 150 deforms and exits through the ruptured diaphragm 130. In the arrangement of Fig. 2, the barrier 150 deforms into a cone shape with the point of the cone directed towards the lowest pressure (i.e. the ruptured diaphragm 130). As such, the edges of the barrier 150 are no longer held in place on the lip or ledge 232 and the barrier is able to move through the air gap 230 and diaphragm 130, and into the passage 222.

[0044] The valve 220 may comprise a feature (not shown) arranged to capture the barrier 150 once it passes through the diaphragm 130, to prevent the barrier 150 from travelling further. This may be achieved by ensuring that the thickness of the passage 222 is less than the thickness of the barrier 150. Alternatively, a capture device such as one or more spikes may be provided within the passage 222 to catch and hold the barrier 150 as it passes therethrough. Alternatively or additionally, a structure, such as a mesh or gauze, may be placed within the passage 222 or outlet 224 that acts to hold back the barrier 150 and/or any other large particles, such as fragments of the diaphragm 130, whilst allowing the fire suppressant to pass through the passage 222.

[0045] In any of these embodiments, the passage must be of sufficient dimensions to allow fire suppressant to exit via the outlet 224, even if the barrier 150 is caught within the passage 222. This could be achieved, for example, by making a height of the passage 222 smaller than the diameter of the barrier 150, but the width of the passage 222 larger than the diameter of the barrier 150.

[0046] Although the present disclosure has been described with reference to the embodiments described above, it will be understood by those skilled in the art that various changes in form and detail may be made.

[0047] For example, the barrier 150 forms part of the valve 200 structure in the embodiment of Fig. 2. However, the barrier 150 could also rest inside the main body of the container 100, e.g. outside of the bottleneck and/or outlet 120.

Claims

1. An apparatus comprising:

   a container (100) for holding a fire suppressant;
   a valve (200) sealing said container (100) and comprising a diaphragm (130) configured to perforate so as to release fire suppressant from said container (100);
   a pyrotechnic charge (140) for perforating said diaphragm (130);
   a barrier (150) configured to prevent contact of fire suppressant with said diaphragm (130) prior to perforation of said diaphragm (130), and to allow fire suppressant to be released from said container (100) after perforation of said diaphragm (130).

2. An apparatus as claimed in claim 1, further comprising a fire suppressant powder within said container (100).

3. An apparatus as claimed in claim 1 or 2, wherein said barrier (150) is a layer of gas-permeable material that sits on a portion (232) of said valve (200) extending into said container (100), and extends across an outlet (120) of said container (100) to prevent contact of fire suppressant with said diaphragm (130) in use.

4. An apparatus as claimed in claim 1, 2 or 3, wherein said barrier (150) is spaced from said diaphragm (130) such that an air gap (230) is present between said barrier (150) and said diaphragm (130).

5. An apparatus as claimed in claim 4, wherein said barrier (150) is configured to substantially prevent fire suppressant powder from entering said air gap (230) prior to perforation of said diaphragm (130).

6. An apparatus as claimed in any preceding claim, wherein said barrier (150) is configured to deform upon perforation of said diaphragm (130) to allow fire suppressant to be released from said container (100).

7. An apparatus as claimed in any preceding claim, wherein said barrier (150) is configured to substantially prevent fire suppressant powder from acting on said diaphragm (130) due to gravity.

8. An apparatus as claimed in any preceding claim, wherein said barrier (150) is gas-permeable.

9. An apparatus as claimed in claim 8, wherein said barrier (150) is a layer of gas-permeable foam.

10. An apparatus as claimed in any preceding claim, wherein said container (100) is pressurised.

11. An apparatus as claimed in any preceding claim, wherein said diaphragm (130) comprises a metal disc.

12. An apparatus as claimed in claim 11, wherein said metal disc is hemispherical, and comprises lines of weakness to aid perforation thereof by said pyrotechnic charge.

13. A method comprising:

   loading fire suppressant into a container (100);
   pressurising said container (100);
   sealing said container (100) with a valve (200), wherein said valve (200) comprises a diaphragm (130) configured to perforate so as to release pressurised fire suppressant from said container (100); and
   providing a temporary barrier (150) between said diaphragm (130) and said fire suppressant, wherein said barrier (150) is configured to prevent contact of said fire suppressant with said diaphragm (130) prior to perforation of said diaphragm (130), and to allow fire suppressant to be released from said container (100) after perforation of said diaphragm (130).

14. A method as claimed in claim 13, further comprising perforating said diaphragm (130) using a pyrotechnic charge (140) so as to cause said pressurised fire suppressant to be released from said container (100).

15. A method as claimed in claim 13 or 14, wherein said step of perforating said diaphragm (130) creates a pressure differential across said barrier (150) that forces said barrier (150) through said ruptured diaphragm (130) and allows fire suppressant to be released from said container (100).

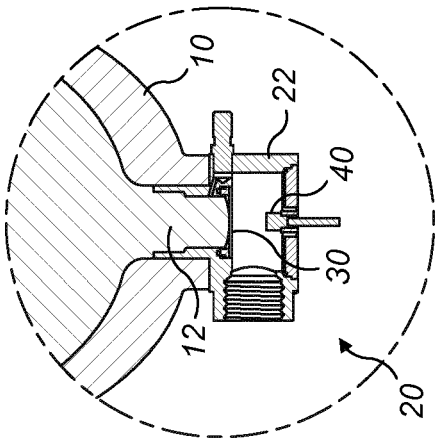


FIG. 1C
(Prior Art)

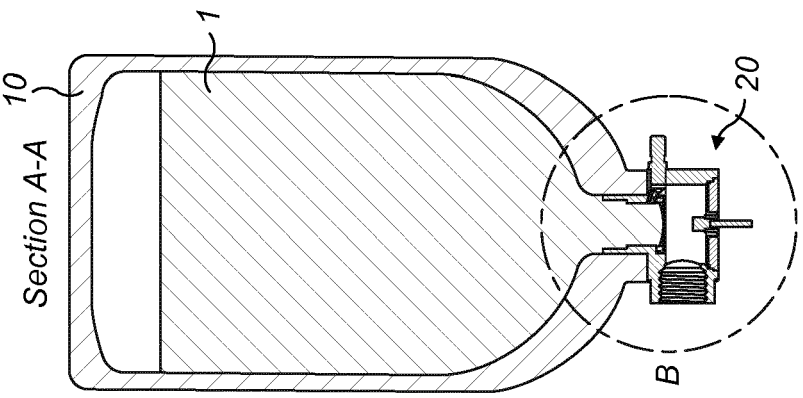


FIG. 1B
(Prior Art)

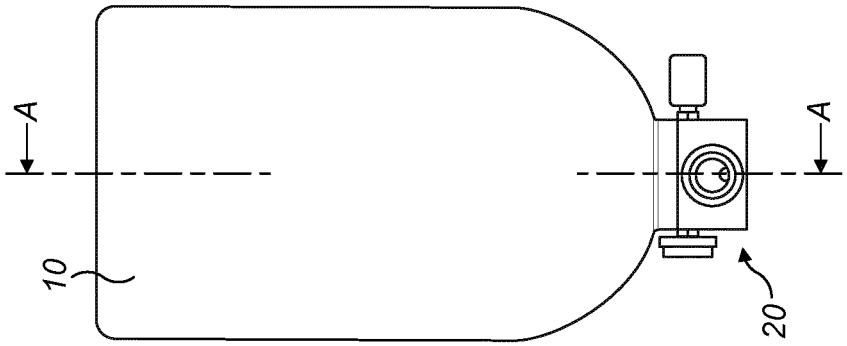


FIG. 1A
(Prior Art)

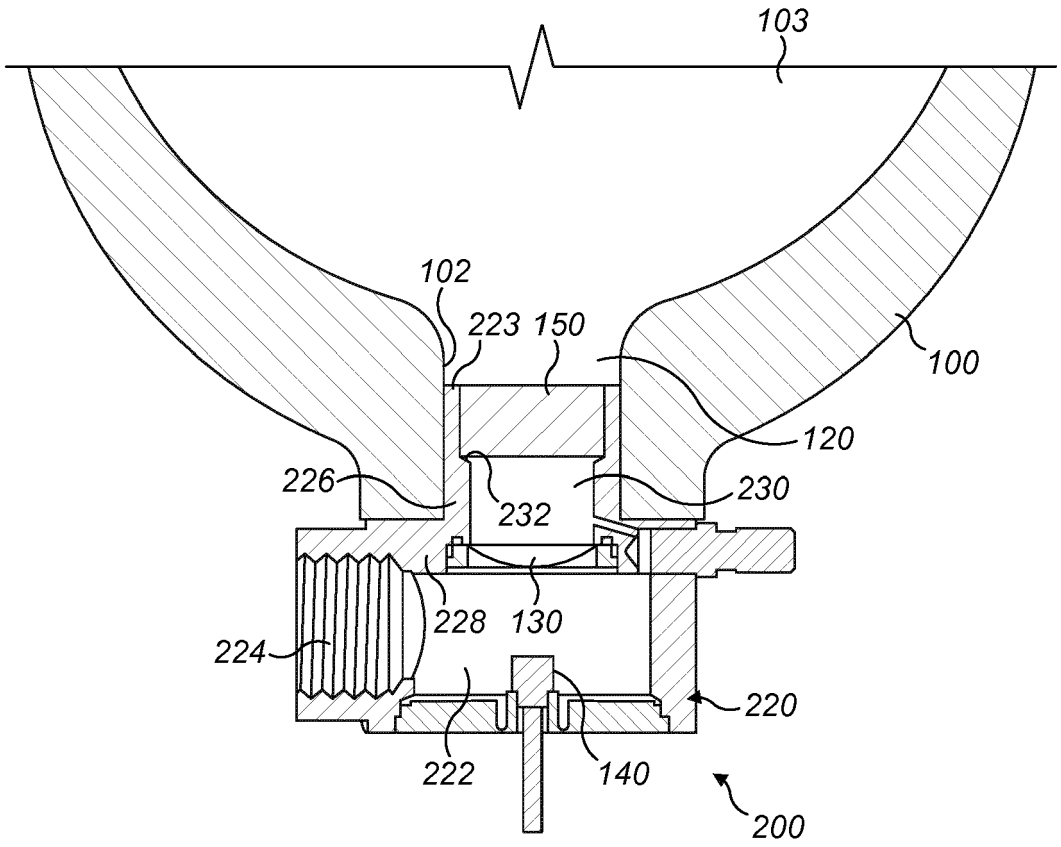


FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 16 15 2109

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 July 2016	Horrix, Doerte

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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