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(54) Title: A SECONDARY CONTAINMENT SYSTEM

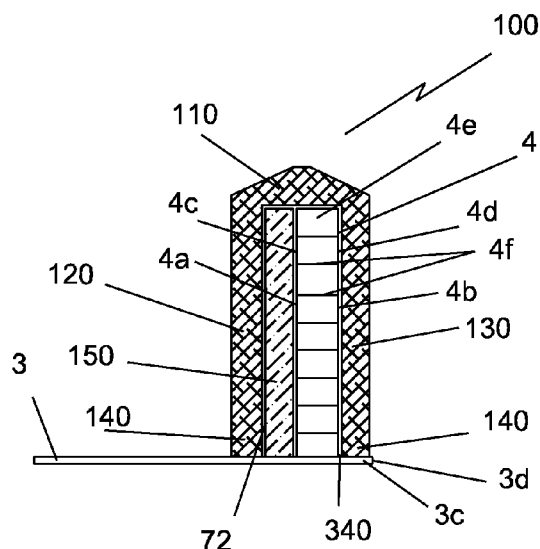
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FIGURE 4

(57) Abstract: A secondary containment system (1) for installing around a ground-based primary vessel (6), the secondary containment system comprising a bund (2) having a base panel (3) and an endless wall (4) defining an enclosure. The bund (2) is made from several prefabricated sections (2a, 2b, 2c, 2d), each pre-fabricated section being itself made from one of more component parts (31-34, 41-48). When the pre-fabricated sections are assembled around the primary vessel a central opening (3b) is defined in the base panel (3), whereby inner edges (30) of the base panel (3) which define the central opening (3b) surround the primary vessel (6). The inner edges (30) are hermetically fastened to a substrate surface (50) on which the primary vessel (6) and the bund (2) are installed to form a continuous liquid-impermeable surface. The bund (2) also comprises a fire-proof cover (100, 170) covering the wall (4) for fire and UV protection.



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A SECONDARY CONTAINMENT SYSTEM

FIELD OF THE INVENTION

The present invention relates to a secondary containment system for a primary vessel,
5 such as, but not limited thereto, a liquid containing vessel.

BACKGROUND OF THE INVENTION

Storage of oil or chemicals in large vessels is inherently linked with a risk of leaks and spillages which in most cases result in environmental contamination. For example, transformer oil
10 is used in oil filled transformers at electrical substations for insulation and as a coolant. Some transformer oils are flammable and environmentally hazardous. In order to prevent the transformer oil from polluting watercourses and soil in the event of a leak in the transformer, or from any other damage as a result of the oil escaping from the transformer, a secondary containment system is usually provided around the transformer. A known secondary containment
15 system is constructed from concrete by laying a concrete floor around the transformer base and then building concrete walls around the floor. This involves considerable amount of excavation work because the concrete slabs which form the walls and the floor of the secondary containment system are partially dug into the ground around the transformer. Installation and deinstallation of such a known system are elaborate and time-consuming. Furthermore, due to the high voltage
20 (e.g. 38kv or 110kV or higher) present at the electrical substation, operators are allowed to remain in the vicinity of the transformer for a very limited period of time. Therefore, in order to construct the known secondary containment system it is necessary to switch off the transformer for a significant time interval. Alternatively, the construction can be carried out intermittently or with frequent change of operators. All the above methods are inconvenient and inefficient.

25 The object of the present invention is to mitigate and obviate the above problems and to provide a secondary containment system which can be rapidly and easily installed at the desired location while at the same time being reliable and robust.

SUMMARY OF THE INVENTION

30 Accordingly, the present invention provides a secondary containment system for containing a substance released from a primary vessel, the secondary containment system comprising a bund, the bund including

a base panel having a central area and a peripheral area; and

a endless wall extending from the peripheral area of the base panel and surrounding the
35 base panel thereby defining an enclosure, the endless wall having an inner face facing the central area of the base panel and an outer face facing away from the central area of the base panel;

wherein the endless wall and the base panel are joined continuously and hermetically;

wherein the endless wall and the base panel are manufactured from a first material, the first material being liquid impermeable;

wherein an opening is formed in the central area of the base panel, the opening being sized and shaped so as to encompass a base portion of a primary vessel when the bund is assembled;

5 wherein the base panel comprises two or more component parts, each component part comprising an inner edge which defines a portion of the central opening, an outer portion remote the inner edge and a pair of opposing side edges connecting the inner edge and the outer portion;

10 wherein the component parts of the base panel are fixedly joined on assembly by joining the side edges of adjacent component parts, whereby the inner edges of the assembled component parts define the central opening, whereby the outer portions of the individual component parts define the peripheral area of the base panel and wherein seams defined between the adjacent side edges of component parts are hermetically sealed;

wherein the endless wall comprises two or more component parts, each component part comprising a free edge remote the base panel, a lower portion remote the free edge and a pair of opposing side edges connecting the free edge and the lower portion;

15 wherein the component parts of the endless wall are joined on assembly by fixedly joining the side edges of adjacent component parts, so that the endless wall surrounds the base panel, and wherein seams defined between the adjacent side edges of component parts are hermetically sealed; and

20 wherein a sealing arrangement is provided for forming upon assembly of the secondary containment system a hermetic seal between the inner edges of the base panel and a substrate surface on which the bund is to be installed, the substrate surface being also the support surface for the primary vessel;

25 wherein, a cover member is provided comprising at least one side wall covering the inner face of the endless wall and a cap portion covering the free edge of the endless wall, the cover member being made from a second material, the second material being fire-proof.

30 Due to the above-described arrangement, the secondary containment system of the present invention can be readily assembled around an existing or a new primary vessel structure and, when required, disassembled, while at the same time being easy to transport, easily and quickly sealable, liquid-tight and fire-proof. The fire-proof cover member protects the material of the endless wall on the inside from a fire which may occur upon ignition of the liquid contained in the bund and on the outside from any external accidental fire outbreak. The fire-proof cover member also protects the material of the endless wall both on the inside and on the outside from damage caused by UV radiation.

35 It will be appreciated that in the present application the terms "inner", "inwardly", "outer", "outwardly" or similar relative terms are used in relation to the central area of the base panel; and terms "upward", "upwardly", "downward", "downwardly", "upper", "lower", "vertical", "horizontal" or similar terms are used in relation to a substrate surface on which the secondary containment system is installed.

Ideally, the cover member comprises a second side wall covering the outer face of the endless wall.

In a preferred embodiment, the cap portion of the cover member has a longitudinal axis and a pair of opposing edges spaced laterally from the longitudinal axis, wherein the side walls
5 depend from the edges to define a generally inverted U-shaped cross-section of the cover member. The cover member is preferably installed over the endless wall whereby the cap portion covers the free edge of the endless wall and the side walls cover respectively the inner and the outer faces of the endless wall. Preferably, a free portion of one or each side wall of the cover member remote the cap portion rests on the base panel.

10 In one preferred arrangement, the cover member is made from, for example, but not limited thereto, fireclay. In this arrangement, the relatively high density of the fireclay material renders the cover member relatively heavy so that the weight of the cover member is sufficient to enable the cover member to serve as a stabiliser and an anchor for the bund.

In a preferred arrangement, the side wall of the cover member at the inner face of the
15 endless wall is spaced from the endless wall in the direction of the central area of the base panel, thereby defining a heat insulation gap between the inner face of the endless wall and the side wall.

In one preferred embodiment, the cover member extends endlessly and concentrically around the endless wall. In a preferred arrangement, a heat insulation panel is accommodated in the heat insulation gap. Ideally a series of heat insulating panels are disposed in the heat
20 insulation gap to form a continuous layer of heat-insulation around the inner face of the endless wall. Preferably, the heat insulation panel is pre-cast from a heat-insulating material, such as for example, lightweight expanded clay aggregate known on the market as Optiroc LWA (light weight aggregate). In another arrangement, the heat insulation gap is filled with a heat-insulating material, such as, for example, but not limited thereto, vermiculite.

25 In one variation, the or each side wall of the cover member comprises a foot portion extending laterally from a free portion of the or each side wall of the cover member remote the cap portion. The foot portion abuts the base panel and thereby provides support for the cover member.

Ideally, the length and shape of the inner edge of each component part of the base panel is
30 selected such that when the base panel is assembled around a primary vessel, each component part of the base panel is placed into a position in which the inner edge of the component part faces the primary vessel by moving the component part so that the inner edge approaches the primary vessel laterally in relation to a vertical axis of the primary vessel. Such an arrangement allows the bund to be installed easily around an existing primary vessel.

35 Due to the provision of the sealing arrangement at the inner edges of the base panel, upon installation of the bund, wherein upon installation of the bund, the substrate surface remains exposed through the central opening and a continuous surface is formed by an upwardly facing surface of the base panel and by the substrate surface exposed through the central opening.

In a most preferred embodiment, the base panel and the endless wall are manufactured from a plastics material, preferably from a weldable plastics material, more preferably from polyethylene and most preferably from a high density polyethylene (HDPE), which is fully recyclable. The advantage of the use of a plastics material, and in particular HDPE, is in that the components of the bund are readily formed, e.g. from pre-manufactured sheets of plastics, the resulting components being relatively light-weight and readily joinable together as required, either away from the location of the primary vessel, when pre-assembled parts of the bund are formed, or when finally assembled around the primary vessel. Furthermore, components of the bund are easily transportable compared to component parts of known secondary containment systems. The assembled bund is relatively inexpensive, light-weight, liquid-tight, fire-proof, robust, reliable, long-lasting and can be easily dismantled if required.

Advantageously, the sealing arrangement at the inner edges of the base panel provides, upon assembly of the secondary containment system, a hermetic seal between the inner edges of the base panel and a substrate surface on which the bund is installed, the substrate surface being also the support surface for the primary vessel. Preferably, the sealing arrangement comprises a gasket member extending endlessly along the inner edges of the base panel for hermetically sealing any passage between the inner edges and the substrate surface. During the installation of the bund, the gasket member becomes sufficiently compressed between the substrate surface and an underside of the inner edges of the base panel to form a leak proof-seal between the inner edges and the substrate surface.

The secondary containment system of the present invention also comprises a fixing arrangement for substantially immovably fastening the inner edges of the base panel of the bund to the substrate surface. The fixing arrangement, in one example, comprises one or more fastening members for mechanically fastening the inner edges to the substrate surface. It will be appreciated that a number of ways of sealing and fixing the inner edges of the base panel to the substrate surface would be apparent to a person skilled in the art. Nevertheless, it has been discovered that a combination of the one or more fastening members for mechanically fastening the inner edges to the substrate surface and the gasket member provides a superior sealed joint between the inner edges and the substrate. Simultaneously, the fastening members serve to fasten the gasket member to the substrate surface in a substantially immovable manner so that displacement of the bund and the gasket member during normal use is prevented.

According to one advantageous example, the fixing arrangement includes a plurality of fastening members, such as, for example, bolts or screws extending through the base panel, through the gasket member and, on assembly, into the substrate surface. Additionally, the fixing arrangement includes a batten member placed over the inner edges and extending along the inner edges of the base panel, wherein the fastening members also extend through the batten thereby spreading a compression force applied to the gasket member when the fastening members cause the compression of the gasket member between the inner edges of the base panel and the substrate surface.

Ideally, the gasket member is made from a resiliently deformable material, which is also preferably resistant to ageing, harsh conditions of the environment and impact from interaction with substances.

In one advantageous variation, the gasket member is made from neoprene, preferably, oil
5 resistant neoprene. In another variation, the sealing arrangement includes a combination of the gasket member and a layer of mastic underneath the gasket member, such a combination being useful where the substrate surface is relatively uneven and/or has imperfections.

Due to the provision of the above described sealing arrangement, upon installation of the bund, a continuous surface is formed by an upwardly facing surface of the base panel and by the
10 portion of the substrate surface exposed through the central opening.

Preferably, the capacity of the bund at least equals, and preferably exceeds, the capacity of the primary vessel.

Ideally, the substrate surface is liquid-impermeable. If necessary however, at least a portion of the substrate surface which in use is exposed through the central opening of the base
15 panel is treated to become liquid-impermeable prior to the installation of the bund. Accordingly, when the bund is assembled, the base panel which is sealingly fastened to the substrate surface and the portion of the substrate surface exposed through the central opening of the base panel form a continuous hermetic base of the bund of the secondary containment system. Ideally, prior to being treated, the substrate surface is first inspected for defects such as cracks or gaps. In one
20 arrangement, the substrate surface is hermetically sealed with a suitable sealant, such as, for example, a fast-setting grout and subsequently coated with a water based sealing compound.

Further advantageously, the inner edges of the base panel and the gasket member each have an inwardly facing minor side face, and the thickness of the base panel and the thickness of the gasket member when compressed between the base panel and the substrate surface are such
25 that when the base panel is sealingly fastened to the substrate surface, a receptacle is defined by the minor side faces of the inner edges of the base panel and the gasket member and by the portion of the substrate surface exposed through the central opening. The combined width of the minor side faces the inner edges of the base panel and the gasket member is sufficient to form a receptacle capable of receiving with a sufficient amount liquid so that the seal formed by the gasket
30 member can be monitored for a pre-determined period of time to leak-test the seal.

In a preferred embodiment, the base panel comprises a collar panel which includes the inner edges of the base panel which define the central opening in the base panel and peripheral edges outwardly spaced from the inner edges, wherein the component parts of the base panel comprise a further set of inner edges which on assembly of the component parts of the base panel
35 surround and are fixedly hermetically sealed with the peripheral edges of the collar panel. Ideally, the collar panel comprises two or more component parts, each component parts including a pair of opposing side edges extending between the inner edge and the peripheral edge of the component part of the collar panel. The component parts of the collar panel are fixedly joined on assembly by joining the side edges of adjacent component parts, whereby the inner edges of the collar panel

define the central opening and wherein seams defined between the adjacent side edges of the component parts of the collar panel are fixedly hermetically sealed. Due to the provision of the collar panel, the seal formed by the gasket member can be leak-tested during early stages of the installation of the bund, without the need to assemble the whole bund.

5 In one instance, the substrate surface which is also a support surface for the primary vessel is a surface of a foundation slab, such as, for example, a concrete plinth.

In an alternative embodiment, portions of the base panel containing the inner edges of the base panel extend upwardly from the remaining upwardly facing surface of the base panel. In this embodiment, the central opening is defined on assembly of the bund by the inner edges of the
10 base panel and by underside surfaces of the upwardly extending portions, wherein the central opening is sized and shaped so that the inner edges of the base panel surround upwardly extending surfaces of a pedestal structure on which a primary vessel rests. In this embodiment, the inner edges are sealingly fastened to the upwardly extending surfaces of the pedestal structure. Ideally, the underside surfaces of the upwardly extending portions of the base panel abut the
15 upwardly extending surfaces of the pedestal structure.

In an advantageous embodiment, the first material (i.e. the material of the endless wall and the base panel) is sufficiently rigid so as to ensure that the configuration of the bund is maintained throughout its life. Furthermore, the first material is, preferably, sufficiently robust in order to enable the bund to hold substantial amount (e.g. 20,000 litres) of any substance (e.g. transformer
20 oil) that may become released from the primary vessel. Ideally, the thicknesses of the endless wall and the base panel are selected accordingly so as to achieve the required rigidity and robustness. Without any limiting effect on the present invention, it has been discovered, that HDPE sheets having the thickness of at least 20mm provide the bund with the above-described desired qualities. Preferably, the second material is also sufficiently rigid so that the position of the
25 second endless wall with regard to the endless wall is maintained in use of the bund.

For additional strength, in a preferred arrangement, the endless wall includes a plurality of reinforcing members. Preferably, the endless wall comprises inner and outer skins and a cavity defined between the skins, wherein a plurality of reinforcing members extend across the cavity between the skins. In one example, a reinforcing member comprises a reinforcing rib. In one
30 arrangement, the reinforcing rib takes the form of a reinforcing panel. Preferably, the reinforcing rib is fixed to and projects from the outer face of the endless wall. In one arrangement, the endless wall is inwardly offset from an outer edge of the base panel thereby defining a flange portion of the base panel. Ideally, the reinforcing rib is fixed to the flange portion of the base panel. It will be appreciated that other variations of reinforcing member are included within the
35 scope of the invention as would be readily apparent to a person skilled in the art.

In one arrangement, the lower portions of the component parts of the endless wall are fixedly joined with the base panel at the peripheral area of the base panel on assembly of the bund and seams therebetween are hermetically sealed. For convenience, grooves can be provided in the base panel for receiving the lower portions of the component parts of the endless wall in order

to aid the pre-assembly of the component parts of the endless wall with the base panel before they are fixedly joined together.

In a preferred arrangement, for each component part of the base section there is provided at least one corresponding component part of the endless wall. Conveniently, prior to assembling
5 the bund, the lower portion of a relevant component part of the endless wall is fixedly joined with the corresponding component part of the base panel at the outer portion of the component part of the base panel, and the seam therebetween is hermetically sealed, thereby defining two or more pre-fabricated sections for a final assembly of the bund.

Accordingly, an assembled bund comprises at least two pre-fabricated sections, each
10 prefabricated section comprising at least one component part of the endless wall and at least one corresponding component part of the base panel, the pre-fabricated sections being fixedly joined on assembly of the bund along side edges of adjacent component parts of the endless wall and along side edges of adjacent component parts of the base panel thereby defining at least two seams, each seam extending continuously from the free edge of a component part of the endless
15 wall to a junction between the lower portion of endless wall and the outer portion of the base panel and to the inner edge of the corresponding component part of the base panel, wherein each seam is hermetically sealed on assembly of the bund.

It will be appreciated that the invention is not limited to the above-described advantageous arrangement, and, indeed, the component parts of the endless wall can, optionally, be assembled
20 with the base panel during the final assembly.

In a more convenient embodiment the bund comprises three, four or five pre-fabricated sections. It will be appreciated that the number of the pre-fabricated sections can vary in various circumstances and the invention is not limited to a particular number of pre-fabricated sections so long as two or more of such sections are provided, enabling the bund to be installed around an
25 existing primary vessel.

On the one hand, most conveniently, especially where the preferred first material (i.e. material of the endless wall and the base panel) is a plastics material, such as polyethylene, and in particular HDPE, the seams defined between the component parts of the endless wall and the base panel and between the component parts of the base panel are hermetically sealed by welding,
30 more preferably by extrusion welding, the latter method being efficient and ergonomic. On the other hand, where welding, and in particular, extrusion welding, are the preferred methods, the use of plastics, such as polyethylene and in particular HDPE is more preferred, since polyethylene, and especially HDPE, are particularly suitable for welding, in particular for extrusion welding. Welding, in particular extrusion welding, not only provides for the hermetic sealing of the seams, it but also
35 securely engages the welded component parts with each other so that no additional fixing means is required to fixedly engage the component parts.

In an advantageous arrangement, a fastening arrangement is provided for securely fastening adjacent component parts of the endless wall to each other during assembly of the bund of the invention. In one aspect, the fastening arrangement pre-secures the component parts of the

endless wall together before the seams between the adjacent components parts are hermetically sealed. In another aspect, the fastening arrangement securely holds the assembled component parts of the endless wall together and prevents mutual displacement thereof during the use of the secondary containment system of the invention. Although the sealed seams between component parts of the endless wall and the base are sufficiently securely joined together during sealing, where the combination of the sealed seam and the fastening arrangement is provided, the sealed seams and the fastening means complement each other thereby further enhancing the strength of the assembled bund.

It will be appreciated that the base panel can have any desired or required shape in plan view. This is particularly easily achieved when the component parts of the base panel and of the endless wall are formed from sheets of plastics material which are readily cut into the desired shapes.

The base panel preferably includes an opening for fitting a sump. Further openings for fitting additional components such as cable or pole chimneys are also included in the base panel in one of the modifications of the invention.

In another aspect, the invention provides a method of manufacturing a secondary containment system for containing a substance released from a primary vessel, the secondary containment system comprising a bund, the method comprising the steps of:

(a) forming two or more component parts of a base panel from a first material, the first material being liquid impermeable, wherein an assembled base panel comprises a central area and a peripheral area and an opening defined in the central area; the opening being sized and shaped so as to encompass a base portion of a primary vessel when the bund is assembled; wherein each component part comprises an inner edge which defines a portion of the central opening, an outer portion remote the inner edge and a pair of opposing side edges connecting the inner edge and the outer portion;

(b) assembling the component parts of the base panel of the bund by joining the side edges of adjacent component parts, whereby the inner edges of the assembled component parts define the central opening, whereby the outer portions of the individual component parts define the peripheral area of the base panel;

(c) hermetically sealing seams defined between the adjacent side edges of component parts;

(d) forming two or more component parts of a endless wall from the first material; wherein each component part comprises a free edge, a lower portion remote the free edge and a pair of opposing side edges connecting the free edge and the lower portion; and

(e) joining component parts of the endless wall to the base panel so that the endless wall extends from the peripheral area of the base panel and surrounds the base panel defining an enclosure, the endless wall having an inner face facing the central area of the base panel and an outer face facing away from the central area of the base panel; and forming a continuous hermetic seal along a seam between the endless wall and the base panel;

(f) forming a hermetic seal between the inner edges of the base panel and a substrate surface on which the bund is being installed, thereby forming a continuous surface defined by an upwardly facing surface of the base panel and by the portion of the substrate surface exposed through the central opening, the substrate surface being also a support surface for the primary vessel; and

(g) providing a cover member comprising at least one side wall covering the inner face of the endless wall and a cap portion covering the free edge of the endless wall, the cover member being made from a second material, the second material being fire-proof.

Preferably, the step (g) further comprises the step of

(h) installing the side wall of the cover member at the inner face of the endless wall so that the side wall of the cover member is spaced from the endless wall in the direction of the central area of the base panel, thereby defining a heat insulation gap between the inner face of the endless wall and the side wall.

Preferably, the method of the present invention further comprises, the step of

(i) immovably fastening the base panel to the substrate surface by mechanically fastening the inner edges of the base panel to the substrate surface.

In a preferred variation, the step (f) includes placing an endless gasket member between the inner edges of the base panel and the substrate surface. Ideally, the step (f) includes compressing the gasket member between the substrate surface and an underside of the inner edges of the base panel thereby forming a leak-proof seal between the inner edges and the substrate surface.

Preferably, prior to the step (f), fastening members are securely fixed to the substrate surface along a location where the gasket member is to be placed and the gasket member is then pre-secured to the fastening members, wherein subsequently, the inner edges of the base panel are placed over the gasket member and pre-secured to the fastening members, wherein optionally, a batten member is placed over the inner edges and pre-secured to the fastening members and wherein subsequently, the fastening members are locked to secure the inner edges and the gasket member in position.

Ideally, the step (f) includes forming a receptacle defined by the portion of the substrate surface exposed through the central opening and by inwardly facing minor side faces of the gasket member and the inner edges of the base panel, wherein the combined width of the gasket member and the inner edges of the base panel is sufficient to render the receptacle suitable for being filled with a sufficient amount of liquid to allow the seal formed by the gasket member to be monitored for a predetermined period of time to leak-test the seal.

If required, prior to the step (a), at least a portion of the support surface which in use is exposed through the central opening of the base panel is treated to become liquid-impermeable prior to the installation of the bund so that when the bund is assembled, the base panel which is sealingly fastened to the support surface and the portion of the support surface exposed through

the central opening of the base panel form a continuous hermetic base of the bund of the secondary containment system.

In a preferred variation, the step (a) includes providing a collar panel which includes the inner edges of the base panel which define the central opening in the base panel and peripheral edges outwardly spaced from the inner edges; wherein the collar panel comprises two or more component parts, each component parts including a pair of opposing side edges extending between the inner edge and the peripheral edge of the component part of the collar panel; fixedly joining the component parts of the collar panel by joining the side edges of adjacent component parts of the collar panel, whereby the inner edges of the collar panel define the central opening and wherein seams defined between the adjacent side edges of the component parts of the collar panel are hermetically sealed; wherein the step of forming the component parts of the base panel includes providing a further set of inner edges of the base panel which define a larger central opening; assembling the component parts of the base panel so that the further inner edges surround the peripheral edges of the collar panel; and fixedly hermetically sealing the further inner edges with the peripheral edges.

Advantageously, prior to placing the component parts of the base panel around the collar panel, the method includes filling the receptacle formed by the portion of the substrate surface exposed through the central opening of the collar panel and by the minor side faces of the gasket member and the inner edges of the collar panel with liquid and leak-testing the seal formed by the gasket member prior to assembling the base panel.

In an alternative variation of the method, the step (a) further comprises forming portions containing the inner edges of the base panel so that they extend upwardly from the remaining upwardly facing surface of the base panel, whereby the central opening is defined on assembly of the bund by the inner edges of the base panel and by underside surfaces of the upwardly extending portions, wherein the central opening is sized and shaped so that the inner edges of the base panel surround upwardly extending surfaces of a pedestal structure on which a primary vessel rests; and sealingly fastening the inner edges to the upwardly extending surfaces of the pedestal structure.

In a further alternative variation of the method, the base panel is continuous and the step of forming the central opening is omitted, wherein the method comprises placing a primary vessel onto the assembled base panel of the bund.

Ideally, the method further includes the step of

(j) filling the heat insulation gap with an insulating material.

Preferably, the step (d) further comprises providing the endless wall with a plurality of reinforcing members.

In one variation, prior, during or after the step (e), side edges of adjacent component parts of the endless wall are fixedly joined and seams defined therebetween are hermetically sealed, wherein during the step (e) the lower portions of the component parts of the endless wall are fixedly

joined with the base panel at the peripheral area of the base panel and seams therebetween are hermetically sealed.

In a preferred variation, the step (d) further comprises providing for each component part of the base section at least one corresponding component part of the endless wall. Preferably, the
5 step (e) further includes fixedly joining the lower portion of a relevant component part of the endless wall with the corresponding component part of the base panel at the outer portion of the component part of the base panel, and hermetically sealing the seam therebetween.

In a more preferred variation, the corresponding component parts of the endless wall and the base panel are assembled prior to the step (b) thereby defining two or more pre-fabricated
10 sections for a final assembly of the bund, wherein the step (b) comprises fixedly joining the pre-fabricated sections along side edges of adjacent component parts of the endless wall and along side edges of adjacent component parts of the base panel, thereby defining at least two seams, each seam extending continuously from the free edge of a component part of the endless wall to a
15 junction between the lower portion of the endless wall and the outer portion of the base panel and to the inner edge of the corresponding component part of the base panel; and hermetically sealing each seam.

In an advantageous arrangement, the method includes securely fastening adjacent component parts of the endless wall to each other during assembly of the bund of the invention using a fastening means.

20 According to an advantageous variation of the method, the seams defined between the component parts of the endless wall and the base panel are hermetically sealed by welding, more preferably by extrusion welding.

In a most preferred embodiment, the method involves forming the component parts of the base panel and of the first endless wall from pre-manufactured sheets of a plastics material,
25 preferably from a weldable plastics material, more preferably from polyethylene and most preferably from a high density polyethylene (HDPE).

The step (b) preferably comprises placing each component part of the base panel into a position in which the inner edge of the component part faces the primary vessel by moving the component part so that the inner edge approaches the primary vessel laterally in relation to a
30 vertical axis of the primary vessel.

Ideally, the method includes the step of leak-testing the assembled bund by filling it with liquid and monitoring for at least 24 hours.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

35 The invention will now be described with reference to the accompanying drawings which show by way of example only embodiments of a secondary containment system according to the invention. In the drawings:

Figure 1 is a perspective schematic view of a secondary containment system in accordance with the invention;

Figure 2 is a plan schematic view of a secondary containment system in accordance with the invention;

Figure 3 is a side view of the secondary containment system of Figure 2;

Figure 4 is a partial cross-sectional elevation of the secondary containment system along the lines A-A in Figure 3 assembled with a fire lining;

Figure 5 is a partial cross-sectional view of a central portion of the secondary containment system; and

Figure 6 is a partial cross-sectional elevation of the secondary containment system along the lines A-A in Figure 3 with an alternative arrangement of a fire lining.

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Referring to Figure 1, the secondary containment system of the invention is indicated generally by reference numeral 1. In the presently described embodiment, the secondary containment system 1 is particularly suitable, although not limited thereto, for installation around a primary vessel 6 (shown in phantom lines in Figure 1) in the form of a transformer at an electric substation for containing transformer oil which may escape the transformer.

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As shown in Figures 1 to 4, the secondary containment system comprises a bund 2. The bund 2 includes a base panel generally indicated by reference numeral 3. The base panel 3 has a central area 3a where a central opening 3b is formed, and a peripheral area 3c having an outer edge 3d. The central opening 3b is sized and shaped so as to encompass a base portion 6a of the primary vessel 6 when the bund 2 is assembled.

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An endless outer wall 4 projects proud from the peripheral area 3c of the base panel 3 and surrounds the base panel 3 defining an enclosure for containing the substance released from the primary vessel 6. The outer wall 4 has an inner face 4a facing the central area 3a of the base panel 3 and an outer face 4b facing away from the central area 3a. The outer wall 4 and the base panel 3 are fixedly joined continuously and hermetically at their interface 340 (Figure 4).

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The outer wall 4 and the base panel 3 are manufactured from a liquid impermeable material. The material of the outer wall 4 and the base panel 3 is also sufficiently rigid so as to ensure that the configuration of the bund 2 is maintained throughout its life. Furthermore, the material of the outer wall 4 and the base panel 3 is sufficiently robust in order to enable the bund 2 to hold substantial amount of substance (e.g. 20,000 litres of transformer oil) that may become released from the primary vessel 6. The thicknesses of the outer wall 4 and the base panel 3 are selected accordingly so as to achieve the required rigidity and robustness. In the presently exemplified embodiment, HDPE sheets having the thickness of at least 20mm provide the bund 2 with the above-described desired qualities, namely, liquid-tightness, robustness and rigidity.

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In the presently described embodiment, the bund 2 is assembled around the primary vessel 6 from four pre-fabricated sections 2a, 2b, 2c and 2d interconnected at seams 8 as will be described below in more detail.

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In the presently described embodiment, the base panel 3 comprises four component parts 31, 32, 33, 34. Each component part 31, 32, 33, 34 comprises an inner edge 30 which defines a

portion of the central opening 3b, an outer edge 38 remote the inner edge 30 and a pair of side edges 39 connecting the inner and outer edges 30, 39 respectively. In the presently described embodiment, as shown in Figures 1 and 2, the base panel 3 comprises a collar panel 65 which includes the inner edges 30 of the base panel 3 which define the central opening 3b. The collar panel 3 includes peripheral edges 65c outwardly spaced from the inner edges 30. The component parts 31, 32, 33, 34 of the base panel 3 have a further set of inner edges 300 which on assembly of the component parts 31, 32, 33, 34 of the base panel 3 surround and are fixedly hermetically sealed with the peripheral edges 65c of the collar panel 65. The collar panel 65 comprises two component parts 65a, 65b. Each component part 65a, 65b includes a pair of opposing side edges 65d extending between the inner edge 30 and the peripheral edge 65c. The component parts 65a, 65b of the collar panel are fixedly joined on assembly by joining the adjacent side edges 65d of the component parts 65a, 65b and seams defined between the adjacent side edges 65d are hermetically sealed.

The outer wall 4 comprises eight component parts 41 to 48, each component part comprising a free edge 49 remote the base panel 3, a lower edge 400 remote the free edge 49 and a pair of opposing side edges 40 connecting the free edge 49 and the lower edge 400. For each component part 31, 32, 33, 34 of the base panel there is provided a corresponding pair of component parts (45, 46), (47, 48), (41, 42), (43, 44) respectively.

Prior to assembling the bund 2, each pair (45, 46), (47, 48), (41, 42), (43, 44) of component parts the outer wall 4 are fixedly joined by the lower edges 400 with a corresponding component part 31, 32, 33, 34 of the base panel 3 at the peripheral area 3c. Adjacent side edges 40 of the component parts of the outer wall 4 within the pairs (45, 46), (47, 48), (41, 42), (43, 44) are also fixedly joined. The joints are securely engaged and hermetically sealed by welding, ideally by extrusion welding, thereby defining four pre-fabricated sections 2a, 2b, 2c and 2d of the bund 2. The pre-fabricated sections 2a, 2b, 2c and 2d are preferably formed remote from the site of the primary vessel 6. Although not shown in the drawings, grooves are formed in the component parts 31, 32, 33, 34 of the base panel 3 for receiving the lower edges 400 of the corresponding component part (45, 46), (47, 48), (41, 42), (43, 44) of the outer wall 4 to aid the correct location of the component part (45, 46), (47, 48), (41, 42), (43, 44) s the outer wall 4 with respect to the component part 31, 32, 33, 34 of the base panel 3.

The pre-fabricated sections 2a, 2b, 2c and 2d are then transported to the site of the primary vessel 6 for final assembly of the bund 2, as will be described below.

The primary vessel 6 is typically installed on a foundation slab, usually, a concrete plinth 50 (see Figure 5). Before assembly, the plinth 50 is first inspected for defects such as cracks or gaps. Next, at least a portion of the surface of the plinth 50 which is intended to be exposed through the central opening 3b of the base panel 3 is treated to become liquid-impermeable. For this purpose, the surface of the plinth is first hermetically sealed with a suitable sealant, such as, for example, a fast-setting grout and subsequently coated with a water based sealing compound.

Next, the collar panel 65 is assembled. Initially, bolts 81 are securely fitted in corresponding apertures (not shown) previously formed in the plinth 50 and arranged around a line along which the inner edges 30 of the collar panel 65 are going to extend. A sealing gasket 68 is then threaded onto the bolts 81 via pre-formed apertures (not shown). The component parts 65a, 65b of the collar panel are then threaded onto the bolts 81 via pre-formed apertures (not shown). Adjacent side edges 65d of the components parts 65a, 65b of the collar panel are fixedly hermetically joined whereby the inner edges 30 of the collar panel define the central opening 3b. A batten 80 extending along each inner edge 30 is then threaded on the bolts 81 via pre-formed apertures (not shown). The batten 80, the inner edges 30 defining the central opening 3b and the sealing gasket 68 are then fastened to the plinth 50 using and a plurality of nuts (not shown). At the same time, the sealing gasket 68 becomes compressed between the plinth 50 and the inner edges 30 of the collar panel 65 thereby forming a leak-proof seal. In this manner the bund 2 is immovably fastened to the plinth 50 and the interface between the inner edges 30 and the plinth 50 becomes hermetically sealed.

A sealing gasket 68 made from oil resistant neoprene has proven to provide a reliable seal. In case the surface of the plinth 50 is relatively uneven so that a reliable seal may not be formed by compressing the sealing gasket 80, a layer of mastic is provided between the sealing gasket 68 and the plinth before the sealing gasket 68 is placed over the bolts 81. It has been discovered that the combination of mechanical fastening and a gasket provides a superior sealed joint between the inner edges 30 and the plinth 50. Accordingly, when the collar panel 65 is assembled the collar panel 65 and the portion of the surface of the plinth 50 exposed through the central opening 3b of the collar panel 65 form a continuous hermetic surface.

As shown in Figure 5, the inner edges 30 of the collar panel 65 and the sealing gasket 68 each have an inwardly facing minor side face 30a, 68a, respectively. The thickness of the collar panel 68 and the thickness of the sealing gasket 68 in the compressed mode are such that the minor side faces 30a, 68a define a wall of a receptacle 55 whereby the portion of the plinth 50 exposed through the central opening 3b defines a base of the receptacle 55. The width of the wall formed by the minor side faces 30a, 68a is sufficient render the receptacle 55 suitable for being filled with a sufficient amount of liquid prior to the installation of the component parts 31, 32, 33, 34 of the base panel 3 in order to leak-test the seal formed by the sealing gasket 68 by monitoring the collar panel 65 for a pre-determined period of time. The above-described arrangement is advantageous in that it allows liquid tightness of the bund to be ascertained rapidly at early stages of the installation of the bund 2.

Subsequently, the pre-fabricated sections 2a, 2b, 2c and 2d are installed around the collar panel 65 so that the inner edges 300 of the component parts 31, 32, 33, 34 of the base panel 3 surround the peripheral edges 65c collar panel 65. The pre-fabricated sections 2a, 2b, 2c and 2d are fixedly hermetically joined along free side edges 40 of adjacent component parts 41 and 48; 42 and 43; 44 and 45; and 46 and 47 of the outer wall 4, a along the side edges 39 of adjacent component parts 31, 32, 33, 34 of the base panel thereby defining the seams 8. Each seam 8

extends continuously from the free edge 49 of the outer wall 4 to the interface 340 between the lower edge 400 of the outer wall 4 and the peripheral area 3c of the base panel 3 and to the inner edges 30 of the base panel 3. The inner edges 300 of the assembled component parts 31, 32, 33, 34 of the base panel 3 are fixedly hermetically joined with the peripheral edges 65c of the collar panel 65.

Although not shown in the drawings, a fastening arrangement is provided for securely fastening adjacent pre-fabricated sections 2a, 2b, 2c and 2d which in one aspect, pre-secures pre-fabricated sections 2a, 2b, 2c and 2d together before the seams 8 between the adjacent pre-fabricated sections 2a, 2b, 2c and 2d are hermetically sealed. In another aspect, the fastening arrangement securely holds pre-fabricated sections 2a, 2b, 2c and 2d together and prevents mutual displacement thereof during the use of the secondary containment system of the invention. Although the sealed seams 8 between pre-fabricated sections 2a, 2b, 2c and 2d are sufficiently securely joined together, the combination of the sealed seam 8 and the fastening arrangement provides the assembled bund 2 with enhanced liquid impermeability, strength and robustness.

The seams 65d defined when the components parts 65a, 65b of the collar panel 65 are pre-assembled and the seams 8 defined when the pre-fabricated sections 2a, 2b, 2c and 2d are pre-assembled are hermetically sealed and securely engaged by welding, more preferably by extrusion welding, the latter method being efficient and ergonomic and providing strong joints between the welded component parts.

As shown in Figure 4, a cover member 100 made from a fire-proof material is provided comprising an elongate (in plan view) cap portion 110 covering the free edge of the wall 4. The elongate cap portion 110 comprises a pair of opposing long edges (not indicated by a numeral). A pair of side walls 120, 130 depend from the long edges of the cap portion 110 to define a generally inverted U-shaped cross-section. The side walls 120, 130 cover respectively the inner and the outer faces 4a, 4b of the outer wall 4. Free lower portions 140 of each side wall 120, 130 remote the cap portion 110 rest on the base panel. The wall 4 comprises inner and outer skins 4c, 4d and a cavity 4e defined between the skins 4c, 4d and a plurality of reinforcing ribs 4f extend across the cavity 4e between the skins 4c, 4d.

One preferred material for the cover member 100 is fireclay. The relatively high density of the fireclay material renders the cover member 100 relatively heavy so that the cover member 100 also serves as a stabiliser and anchor for the bund 2.

Also as shown in Figure 4, the side wall 120 of the cover member 100 at the inner face 4a of the wall 4 is spaced from the wall 4 in the direction of the central area of the base panel 2, thereby defining a heat insulation gap 72 between the inner face 4a of the wall 4 and the side wall 120. The cover member 100 extends endlessly and concentrically around the wall 4. A series of heat insulation panels 150 are accommodated in the heat insulation gap 72 to form an endless layer of heat-insulation around the inner face 4a of the wall 4. Preferably, the heat insulation panel 150 is pre-cast from a heat-insulating material, such as for example, LECA (lightweight expanded

clay aggregate) known on the market as Optiroc LWA (light weight aggregate). Alternatively, the insulation gap 72 can be filled with an insulating material, e.g. vermiculite.

Figure 6 shows an alternative arrangement of a fire-proof cover member 170, which is similar to the cover member 100 of Figure 4. The cover member 170 comprises a side wall 70 at an inner face 440a of a wall 440.

The side wall 70 comprises a foot portion 75 extending inwardly from a lower edge 74 of the side wall 70 adjacent the base panel 3. The foot portion 75 abuts the base panel 3 and thereby supports the side wall 70 in its position. Although not shown in the drawing, for additional stability, a joint can be formed between the foot portion 75 and the base panel 3. A second side wall 71 covers an outer face 440b of the wall 440. A separate cap portion 90 covers an open end 72a of the heat insulation gap 72 adjacent free edges of the outer wall 440 and the side wall 70 remote the base panel 3. The cap portion 90 comprises an elongate capping slat 91 having an upper face 92 and a base face 93. Substantially parallel grooves 94, 95 are formed in the base face 93 extending along the length of the capping slat 91. Groove 94 is profiled so as to fit over the free edge of the side wall 70 and groove 95 is profiled so as to fit over the free edge of the wall 440. Several capping slats 91 are provided mounted end to end so as to form the continuous endless capping structure. The capping member 90 is preferably made from a fire-proof material and in the presently described embodiment the capping member 90 is made from the same material as the walls 70, 71, i.e. fireclay.

As shown in Figures 2 and 3, the base panel includes an opening 17 for fitting a sump 18.

Upon assembly, the bund 2 is filled with liquid (e.g. water) and is leak-tested by monitoring the bund 2 for at least 24 hours.

In another embodiment not shown in the drawings, the component parts 65a, 65b of the collar panel 65 are configured so that upon assembly of the collar panel 65 the component parts 65a, 65b extend substantially upright in relation to the base panel 3 and the inner edges 30 are positioned uppermost in relation to the base panel 3. This embodiment is particularly suitable for the installation around a primary vessel which is mounted on a pedestal resting on the plinth 50. In this embodiment, the central opening 3b is defined on assembly of the bund 2 by the inner edges 30 of collar panel 65 and by underside surfaces thereof. The resulting central opening 3b is sized and shaped so that the inner edges 30 of the collar panel 65 surround upwardly extending surfaces of the pedestal. In this embodiment, the inner edges 30 are sealingly fastened to the upwardly extending surfaces of the pedestal and the underside surfaces of the collar panel 65 abut the upwardly extending surfaces of the pedestal.

It will be appreciated by those skilled in the art that variations and modifications can be made without departing from the scope of the invention as defined in the appended claims.

CLAIMS:

1. A secondary containment system for containing a substance released from a primary vessel, the secondary containment system comprising a bund, the bund including
- 5 a base panel having a central area and a peripheral area; and
- a endless wall extending from the peripheral area of the base panel and surrounding the base panel thereby defining an enclosure, the endless wall having an inner face facing the central area of the base panel and an outer face facing away from the central area of the base panel;
- wherein the endless wall and the base panel are joined continuously and hermetically;
- 10 wherein the endless wall and the base panel are manufactured from a first material, the first material being liquid impermeable;
- wherein an opening is formed in the central area of the base panel, the opening being sized and shaped so as to encompass a base portion of a primary vessel when the bund is assembled;
- 15 wherein the base panel comprises two or more component parts, each component part comprising an inner edge which defines a portion of the central opening, an outer portion remote the inner edge and a pair of opposing side edges connecting the inner edge and the outer portion;
- wherein the component parts of the base panel are fixedly joined on assembly by joining the side edges of adjacent component parts, whereby the inner edges of the assembled
- 20 component parts define the central opening, whereby the outer portions of the individual component parts define the peripheral area of the base panel and wherein seams defined between the adjacent side edges of component parts are hermetically sealed;
- wherein the endless wall comprises two or more component parts, each component part comprising a free edge remote the base panel, a lower portion remote the free edge and a pair of
- 25 opposing side edges connecting the free edge and the lower portion;
- wherein the component parts of the endless wall are joined on assembly by fixedly joining the side edges of adjacent component parts, so that the endless wall surrounds the base panel, and wherein seams defined between the adjacent side edges of component parts are hermetically sealed; and
- 30 wherein a sealing arrangement is provided for forming upon assembly of the secondary containment system a hermetic seal between the inner edges of the base panel and a substrate surface on which the bund is to be installed, the substrate surface being also the support surface for the primary vessel;
- wherein, a cover member is provided comprising at least one side wall covering the inner
- 35 face of the endless wall and a cap portion covering the free edge of the endless wall, the cover member being made from a second material, the second material being fire-proof.
2. A secondary containment system as claimed in Claim 1, wherein the cover member comprises a second side wall covering the outer face of the endless wall.

3. A secondary containment system as claimed in Claim 2, wherein the cap portion of the cover member has a longitudinal axis and a pair of opposing edges spaced laterally from the longitudinal axis, wherein each side wall depends from a respective edge to define a generally inverted U-shaped cross-section of the cover member; wherein the cover member is installed over the endless wall whereby the cap portion covers the free edge of the endless wall and the side walls cover respectively the inner and the outer faces of the endless wall.
4. A secondary containment system as claimed in Claim 3, wherein a free portion of one or each side wall of the cover member remote the cap portion rests on the base panel.
5. A secondary containment system as claimed in any preceding claim, wherein the side wall of the cover member at the inner face of the endless wall is spaced from the endless wall in the direction of the central area of the base panel, thereby defining a heat insulation gap between the inner face of the endless wall and the side wall.
6. A secondary containment system as claimed in Claim 5, wherein a heat insulation panel is accommodated in the heat insulation gap.
7. A secondary containment system as claimed in Claim 6, wherein a series of heat insulating panels are disposed in the heat insulation gap to form continuous layer of heat-insulation around the inner face of the endless wall.
8. A secondary containment system as claimed in Claim 6 or Claim 7, wherein the heat insulation panel is pre-cast from a heat-insulating material.
9. A secondary containment system as claimed in Claim 8, wherein the heat-insulating material comprises LECA (lightweight expanded clay aggregate).
10. A secondary containment system as claimed in Claim 5, wherein the heat insulation gap is filled with a heat-insulating material.
11. A secondary containment system as claimed in Claim 10, wherein the heat-insulating material comprises vermiculite.
12. A secondary containment system as claimed in any preceding claim, wherein the cover member is made from fireclay.

13. A secondary containment system as claimed in Claim 12, wherein the weight of the cover member is sufficient to enable the cover member to function as a stabiliser and an anchor for the bund.
- 5 14. A secondary containment system as claimed in any preceding claim, wherein one or each side wall of the cover member comprises a foot portion extending laterally from a free portion of the or each side wall of the cover member remote the cap portion, wherein the foot portion abuts the base panel and thereby provides support for the cover member.
- 10 15. A secondary containment system as claimed in any preceding claim, wherein the cover member extends endlessly and concentrically around the endless wall.
16. A secondary containment system as claimed in any preceding claim, wherein upon installation of the bund, the substrate surface remains exposed through the central opening and a
15 continuous surface is formed by an upwardly facing surface of the base panel and by the substrate surface exposed through the central opening.
17. A secondary containment system as claimed in Claim 16, wherein the substrate surface is liquid-impermeable, so that when the bund is assembled, the base panel which is sealingly
20 fastened to the substrate surface and the substrate surface exposed through the central opening of the base panel form a continuous hermetic base of the bund of the secondary containment system.
18. A secondary containment system as claimed in Claim 16 or claim 17, wherein the sealing arrangement comprises a gasket member extending endlessly along the inner edges of the base
25 panel for hermetically sealing any passage between the inner edges and the substrate surface.
19. A secondary containment system as claimed in Claim 18, wherein the material, the shape and size of the gasket member are selected such that during the installation of the bund, the gasket member becomes sufficiently compressed between the substrate surface and an underside of the
30 inner edges of the base panel to form a leak proof-seal between the inner edges and the substrate surface.
20. A secondary containment system as claimed in Claim 18 or Claim 19, wherein the secondary containment system of the present invention also comprises a fixing arrangement for
35 substantially immovably fastening the inner edges of the base panel of the bund to the substrate surface.

21. A secondary containment system as claimed in Claim 20, wherein the fixing arrangement comprises one or more fastening members for mechanically fastening the inner edges to the substrate surface.
- 5 22. A secondary containment system as claimed in Claim 21, wherein the fastening members extend through the base panel, through the gasket member and, on assembly, into the substrate surface.
- 10 23. A secondary containment system as claimed in Claim 22, wherein the fixing arrangement includes a batten member placed over the inner edges and extending along the inner edges of the base panel, wherein the fastening members also extend through the batten thereby spreading a compression force applied to the gasket member when the fastening members cause the compression of the gasket member between the inner edges of the base panel and the substrate surface.
- 15 24. A secondary containment system as claimed in any one of Claims 18 to 23, wherein the gasket member is made from a resiliently deformable material, which is also resistant to ageing, harsh conditions of the environment and impact from interaction with substances.
- 20 25. A secondary containment system as claimed in any one of Claims 18 to 24, wherein the gasket member is made from neoprene.
- 25 26. A secondary containment system as claimed in any one of Claims 18 to 25, wherein a layer of mastic is provided underneath the gasket member.
- 30 27. A secondary containment system as claimed in any one of Claims 18 to 26, wherein the inner edges of the base panel and the gasket member each have an inwardly facing minor side face, and the thickness of the base panel and the thickness of the gasket member when compressed between the base panel and the substrate surface are such that when the base panel is sealingly fastened to the substrate surface, a receptacle is defined by the minor side faces of the inner edges of the base panel and the gasket member and by the portion of the substrate surface exposed through the central opening, wherein the combined width of the minor side faces of the inner edges of the base panel and the gasket member is sufficient to form a receptacle capable of receiving a sufficient amount liquid so that the seal formed by the gasket member can be monitored
- 35 for a pre-determined period of time to leak-test the seal.
28. A secondary containment system as claimed Claim 27, wherein the base panel comprises a collar panel which includes the inner edges of the base panel which define the central opening in the base panel and peripheral edges outwardly spaced from the inner edges, wherein the

component parts of the base panel comprise a further set of inner edges which on assembly of the component parts of the base panel surround and are fixedly hermetically sealed with the peripheral edges of the collar panel.

5 29. A secondary containment system as claimed in Claim 28, wherein the collar panel comprises two or more component parts, each component parts including a pair of opposing side edges extending between the inner edge and the peripheral edge of the component part of the collar panel, wherein the component parts of the collar panel are fixedly joined on assembly by joining the side edges of adjacent component parts, whereby the inner edges of the collar panel
10 define the central opening and wherein seams defined between the adjacent side edges of the component parts of the collar panel are fixedly hermetically sealed; thereby allowing the seal formed by the gasket member to be leak-tested prior to assembling the base panel.

15 30. A secondary containment system as claimed in any preceding claim, wherein the base panel and the endless wall are manufactured from a weldable plastics material.

31. A secondary containment system as claimed in Claim 30, wherein the base panel and the endless wall are manufactured from a high density polyethylene (HDPE).

20 32. A secondary containment system as claimed in Claim 1, wherein portions of the base panel containing the inner edges of the base panel extend upwardly from the remaining upwardly facing surface of the base panel and the central opening is defined on assembly of the bund by the inner edges of the base panel and by underside surfaces of the upwardly extending portions, wherein the central opening is sized and shaped so that the inner edges of the base panel
25 surround upwardly extending surfaces of a pedestal structure on which a primary vessel rests, wherein the inner edges are sealingly fastened on assembly to the upwardly extending surfaces of the pedestal structure.

30 33. A secondary containment system as claimed in any preceding claim, wherein the endless wall comprises inner and outer skins and a cavity defined between the skins, wherein a plurality of reinforcing ribs extend across the cavity between the skins.

34. A secondary containment system as claimed in any preceding claim, wherein for each component part of the base section there is provided at least one corresponding component part of the endless wall and wherein prior to assembling the bund, the lower portion of a relevant component part of the endless wall is fixedly joined with the corresponding component part of the base panel at the outer portion of the component part of the base panel, and the seam therebetween is hermetically sealed, thereby defining two or more pre-fabricated sections for a final assembly of the bund.
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35. A secondary containment system as claimed in any preceding claim, wherein, an assembled bund comprises at least two pre-fabricated sections, each prefabricated section comprising at least one component part of the endless wall and at least one corresponding
5 component part of the base panel, the pre-fabricated sections being fixedly joined on assembly of the bund along side edges of adjacent component parts of the endless wall and along side edges of adjacent component parts of the base panel thereby defining at least two seams, each seam extending continuously from the free edge of a component part of the endless wall to a junction between the lower portion of endless wall and the outer portion of the base panel and to the inner
10 edge of the corresponding component part of the base panel, wherein each seam is hermetically sealed on assembly of the bund.

36. A secondary containment system as claimed in any preceding claim, wherein the first material is a plastics material and wherein the seams defined between the component parts of the
15 endless wall and the base panel and between the component parts of the base panel are hermetically sealed by welding.

37. A method of manufacturing a secondary containment system for containing a substance released from a primary vessel, the secondary containment system comprising a bund, the method
20 comprising the steps of:

(a) forming two or more component parts of a base panel from a first material, the first material being liquid impermeable, wherein an assembled base panel comprises a central area and a peripheral area and an opening defined in the central area; the opening being sized and shaped so as to encompass a base portion of a primary vessel when the bund is assembled; wherein
25 each component part comprises an inner edge which defines a portion of the central opening, an outer portion remote the inner edge and a pair of opposing side edges connecting the inner edge and the outer portion;

(b) assembling the component parts of the base panel of the bund by joining the side edges of adjacent component parts, whereby the inner edges of the assembled component parts
30 define the central opening, whereby the outer portions of the individual component parts define the peripheral area of the base panel;

(c) hermetically sealing seams defined between the adjacent side edges of component parts;

(d) forming two or more component parts of a endless wall from the first material; wherein each component part comprises a free edge, a lower portion remote the free edge and a pair of opposing side edges connecting the free edge and the lower portion; and
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(e) joining component parts of the endless wall to the base panel so that the endless wall extends from the peripheral area of the base panel and surrounds the base panel defining an enclosure, the endless wall having an inner face facing the central area of the base panel and an

outer face facing away from the central area of the base panel; and forming a continuous hermetic seal along a seam between the endless wall and the base panel;

(f) forming a hermetic seal between the inner edges of the base panel and a substrate surface on which the bund is being installed, thereby forming a continuous surface defined by an upwardly facing surface of the base panel and by the substrate surface exposed through the central opening, the substrate surface being also a support surface for the primary vessel; and

(g) providing a cover member comprising at least one side wall covering the inner face of the endless wall and a cap portion covering the free edge of the endless wall, the cover member being made from a second material, the second material being fire-proof.

38. A method of Claim 37, comprising the step of:

(h) installing the side wall of the cover member at the inner face of the endless wall so that the side wall of the cover member is spaced from the endless wall in the direction of the central area of the base panel, thereby defining a heat insulation gap between the inner face of the endless wall and the side wall.

39. A method of Claim 37 or claim 38, comprising the step of:

(i) immovably fastening the base panel to the substrate surface by mechanically fastening the inner edges of the base panel to the substrate surface.

40. A method of any one of Claims 37 to 39, wherein the step (f) includes placing an endless gasket member between the inner edges of the base panel and the substrate surface.

41. A method of Claim 40, wherein the step (f) includes compressing the gasket member between the substrate surface and an underside of the inner edges of the base panel thereby forming a leak-proof seal between the inner edges and the substrate surface.

42. A method of Claims 40 or 41, wherein prior to the step (f), fastening members are securely fixed to the substrate surface along a location where the gasket member is to be placed and the gasket member is then pre-secured to the fastening members, wherein subsequently, the inner edges of the base panel are placed over the gasket member and pre-secured to the fastening members.

43. A method of Claim 42, wherein a batten member is placed over the inner edges and pre-secured to the fastening members and wherein subsequently, the fastening members are locked to secure the inner edges and the gasket member in position.

44. A method of any one of Claims 40 to 43, wherein the step (f) includes forming a receptacle defined by the portion of the substrate surface exposed through the central opening and by inwardly facing minor side faces of the gasket member and the inner edges of the base panel, wherein the combined width of the gasket member and the inner edges of the base panel is sufficient to render the receptacle suitable for being filled with a sufficient amount of liquid to allow the seal formed by the gasket member to be monitored for a predetermined period of time to leak-test the seal.

45. A method of any one of Claims 37 to 44, wherein prior to the step (a), the substrate surface which in use is exposed through the central opening of the base panel is treated to become liquid-impermeable prior to the installation of the bund so that when the bund is assembled, the base panel which is sealingly fastened to the substrate surface and the substrate surface exposed through the central opening of the base panel form a continuous hermetic base of the bund of the secondary containment system.

46. A method of Claim 44, wherein the step (a) includes providing a collar panel which includes the inner edges of the base panel which define the central opening in the base panel and peripheral edges outwardly spaced from the inner edges; wherein the collar panel comprises two or more component parts, each component parts including a pair of opposing side edges extending between the inner edge and the peripheral edge of the component part of the collar panel; fixedly joining the component parts of the collar panel by joining the side edges of adjacent component parts of the collar panel, whereby the inner edges of the collar panel define the central opening and wherein seams defined between the adjacent side edges of the component parts of the collar panel are hermetically sealed; wherein the step of forming the component parts of the base panel includes providing a further set of inner edges of the base panel which define a larger central opening; assembling the component parts of the base panel so that the further inner edges surround the peripheral edges of the collar panel; and fixedly hermetically sealing the further inner edges with the peripheral edges.

47. A method of Claim 46, wherein prior to placing the component parts of the base panel around the collar panel, the method includes filling the receptacle formed by the portion of the substrate surface exposed through the central opening of the collar panel and by the minor side faces of the gasket member and the inner edges of the collar panel with liquid and leak-testing the seal formed by the gasket member prior to assembling the base panel.

48. A method of Claim 47 comprising the step of:
(j) placing an insulating material in the heat insulation gap.

49. A method of any one of Claims 37 to 48, wherein prior, during or after the step (e), side edges of adjacent component parts of the endless wall are fixedly joined and seams defined therebetween are hermetically sealed, wherein during the step (e) the lower portions of the component parts of the endless wall are fixedly joined with the base panel at the peripheral area of the base panel and seams therebetween are hermetically sealed.

50. A method of any one of Claims 37 to 49, wherein the step (d) further comprises providing for each component part of the base section at least one corresponding component part of the endless wall.

51. A method of any one of Claims 37 to 50, wherein the step (e) further includes fixedly joining the lower portion of a relevant component part of the endless wall with the corresponding component part of the base panel at the outer portion of the component part of the base panel, and hermetically sealing the seam therebetween.

52. A method of any one of Claims 37 to 51, wherein the corresponding component parts of the endless wall and the base panel are assembled prior to the step (b) thereby defining two or more pre-fabricated sections for a final assembly of the bund, wherein the step (b) comprises fixedly joining the pre-fabricated sections along side edges of adjacent component parts of the endless wall and along side edges of adjacent component parts of the base panel, thereby defining at least two seams, each seam extending continuously from the free edge of a component part of the endless wall to a junction between the lower portion of the endless wall and the outer portion of the base panel and to the inner edge of the corresponding component part of the base panel; and hermetically sealing each seam.

53. A method of any one of Claims 37 to 52, wherein the method includes securely fastening adjacent component parts of the endless wall to each other during assembly of the bund of the invention using a fastening means.

54. A method of any one of Claims 37 to 53, wherein the seams defined between the component parts of the endless wall and the base panel are hermetically sealed by welding.

55. A method of any one of Claims 37 to 54, wherein the method includes the step of leak-testing the assembled bund by filling it with liquid and monitoring for at least 24 hours.

56. A method of Claim 37, wherein the base panel is continuous and the step of forming the central opening is omitted, wherein the method comprises placing a primary vessel onto the assembled base panel of the bund.

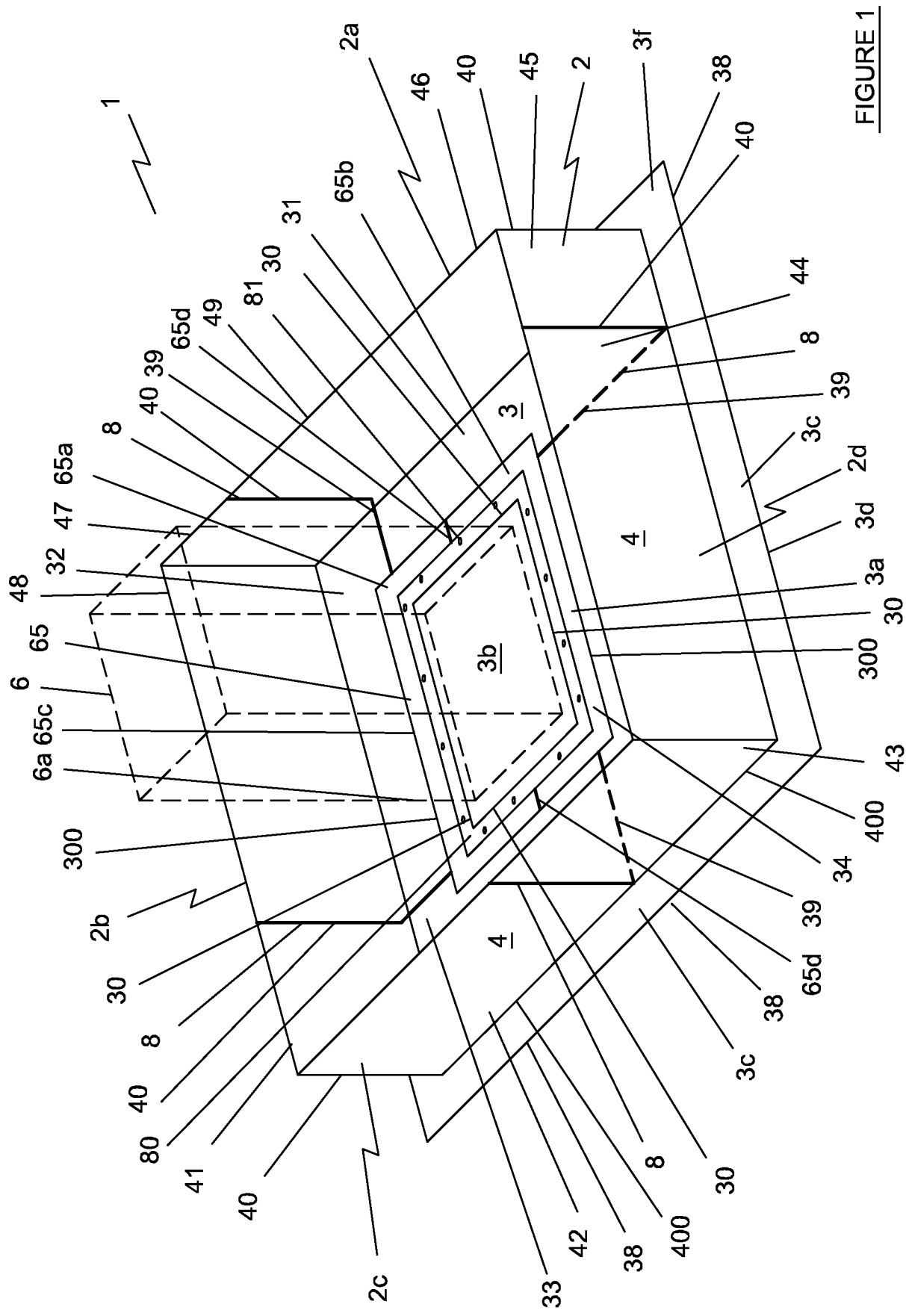
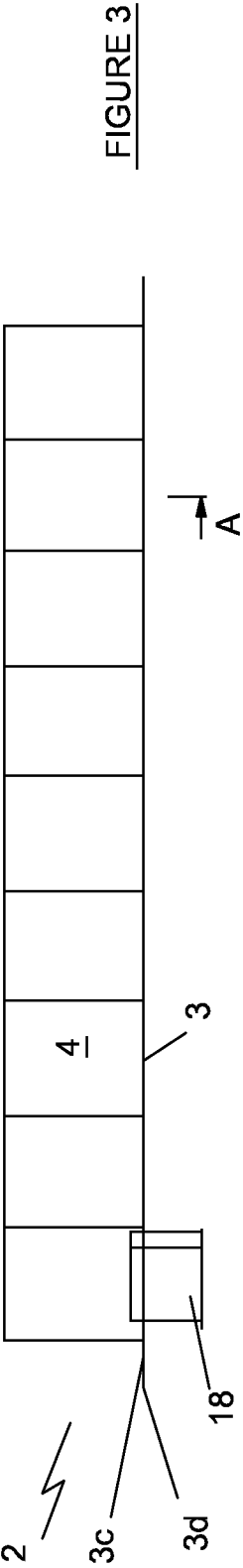
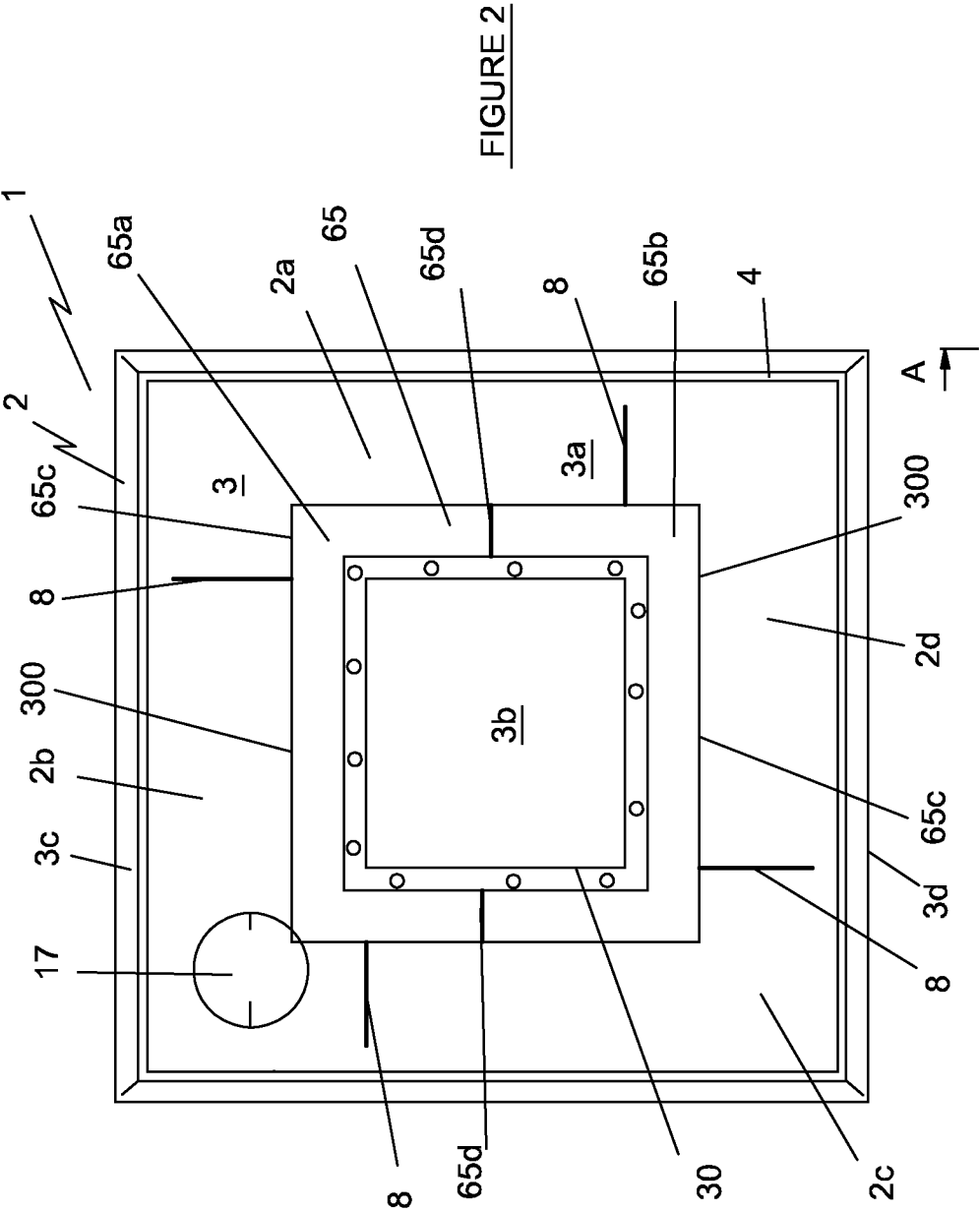
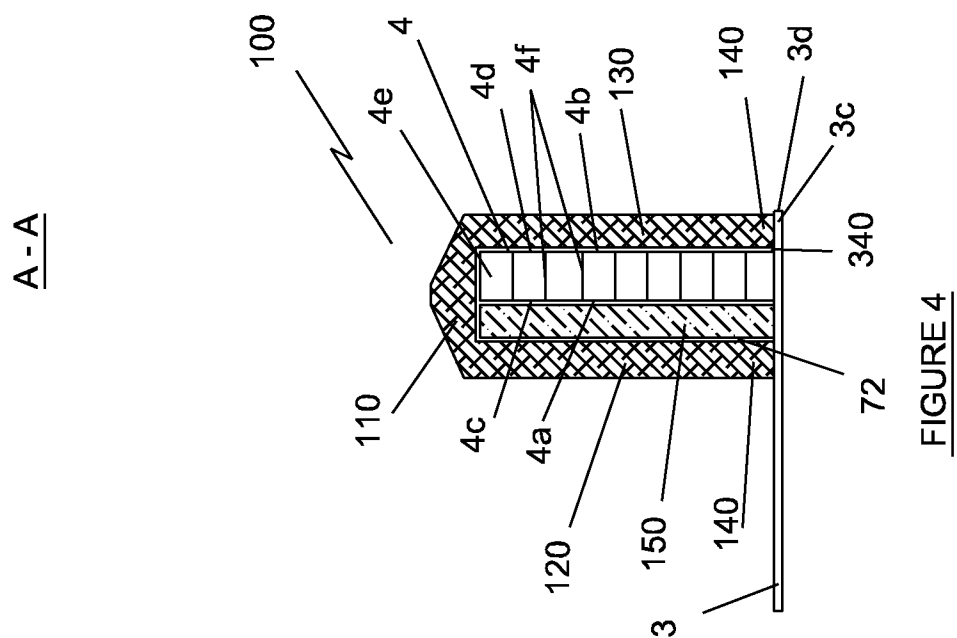
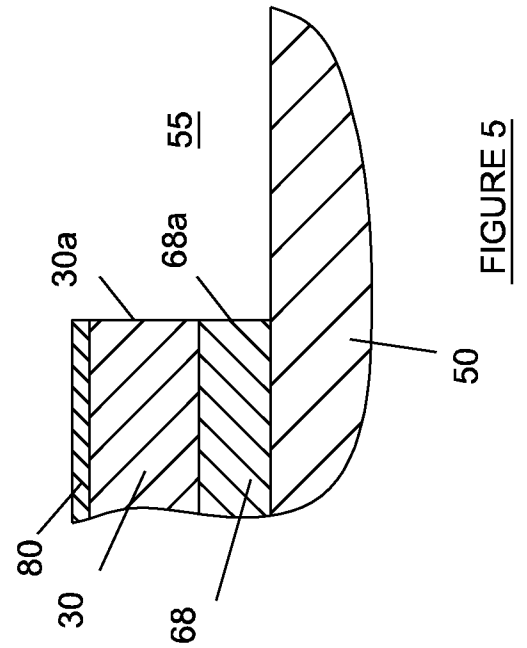
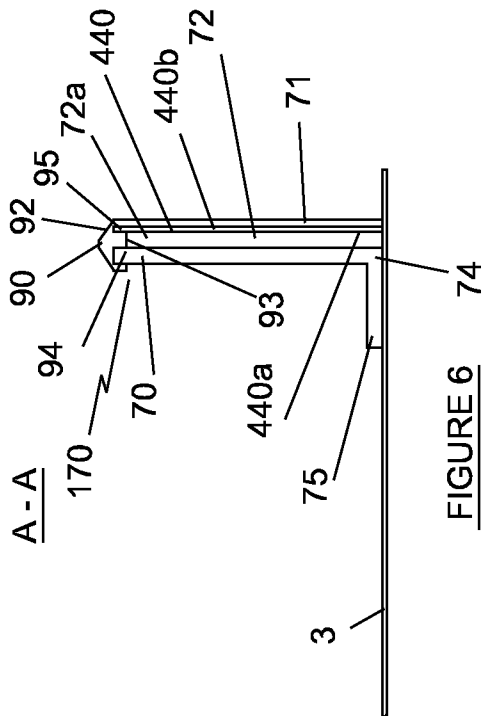


FIGURE 1





INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/064163

A. CLASSIFICATION OF SUBJECT MATTER INV. E04H5/04 H01F27/06 H01F27/14 E04H4/00 ADD.				
According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B65D H01F E04H				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EP0-Internal				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	GB 2 456 041 A (ANDEL LTD [GB]) 1 July 2009 (2009-07-01) page 1, line 3 - page 10, line 6; figures 1-13 -----	1-56		
X	US 5 689 920 A (HALLSTEN JEFFREY A [US]) 25 November 1997 (1997-11-25) column 1, line 8 - column 8, line 7; figures 1,1a,1b -----	1,37		
A	EP 0 542 605 A1 (BOULONNAIS TERRES REFRACTAIRES [FR]) 19 May 1993 (1993-05-19) column 2, line 49 - column 4, line 43; figures 1-6 ----- -/--	1-56		
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.				
* Special categories of cited documents : <table border="0"> <tr> <td> "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family </td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family			
Date of the actual completion of the international search 7 February 2011		Date of mailing of the international search report 18/02/2011		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Lämme1, Gunnar		

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/064163

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 1 123 878 A2 (ROTH WERKE GMBH [DE]) 16 August 2001 (2001-08-16) paragraph [0019]; figures 1,2 -----	1-56

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