Paper C part 1:

Notice of opposition is filed against European Patent No. EP 3141592 B1, granted to Winterwute Corp. and entitled Underwater Energy Storage Device.

The Opponent is Waterhole Science Laboratories of 4252 Country Club Drive, Long Beach CA 90807, USA

The Opponent is represented by Ms Molly Dorsett Pauley, Todiet Kwiscus LLC, 23 Radley Bridge Street, Snowdonia, LL55 4TY, Great Britain.

We request revocation of the Patent (Annex 1; A1) in its entirity (all claims are opposed). The Patent is opposed under Art 100(a) EPC on the grounds of lack of novelty and lack of inventive step. The facts and evidence in support of these grounds are set out below.

The opposition fee has been paid by deposit account.

If the Opposition Division intends to reach a decision other than revocation of the patent, then oral proceedings are requested.

Effective dates of the claims of A1:

A1 claims priority from NO20150000333 ('P1') and NO20150000355 ('P2').

Claim 1 was present in both P1 and P2. It is therefore entitled to the first priority date and has an effective date of 11 March 2015.

Claims 2 and 3 were present in P2 but not P1. P1 only contains paragraphs [0001] to [0011] of the application and Figures 1-3.

Claim 2 is directed to the device including the first and second reinforcing arrangements (32,34) which are described in paragraphs [0012] - [0016] of the application and in Figure 4. None of these sections are present in P1 as there is no basis in paragraphs [0001] - [0011] for these embodiments. Claim 2 is therefore entitled to the second priority date of 10 June 2015.

Claim 3 is directed to the plurality of devices described in paragraph [0017] of the application. There is no basis for this feature elsewhere in the application. It is noted that paragraph [0006] mentions the need to facilitate installation of a plurality of devices in an array, but there is no disclosure in [0006] that the devices are connected to a common pump and common turbine as required in claim 3. Claim 3 is therefore entitled to the second priority date of 10 June 2015.

Documents relied on

Annex 2 (A2), 'European Scientist' magazine excerpt published 6 August 2015.

Annex 3 (A3), US 9,109,358, patent dated 3 January 2012

Annex 4 (A4), EP2717281, priority 2 October 2013, filed 5 October 2014, published 6 April 2015

Annex 5 (A5), US 6,626,070, patent dated 6 January 1980

Annex 6 (A6), DE 101 6021 7662.0, published 6 September 2014.

A2 was published after the effective dates of claims 1-3 of A1. A2 is not therefore prior art for claims 1-3.

A3, A5 and A6 were all published before the first priority date of A1, and therefore also before the effective dates of claims 1-3 of A1.

A3, A5 and A6 are therefore prior art under Art 54(2) EPC for claims 1-3 and are available for novelty and inventive step.

A4 was filed before the first priority date of of A1. It was published in between the first and second priority dates. A4 was therefore filed before the effective date of claim 1 of A1, but published afterwards. It is therefore prior art under Art 54(3) EPC for claim 1 and is available for novelty only.

A4 was published before the effective dates of claims 2 and 3 of A1. A4 is therefore prior art under Art 54(2) EPC for claims 2-3 of A1 and is available for novelty and inventive step.

Novelty and inventive step:

Claim 1

Claim 1 lacks novelty over A3, because A3 discloses all of the features of claim 1 as follows:

An underwater energy storage device

A3 [0001] states that the invention relates to an energy container array into which vessels can be inserted and extracted underwater. It is therefore an underwater device.

A1 in [0002] states that there are certain components necessary for underwater hydroelectrical energy storage, namely an electric motor, pump, turbine and generator. [0003] of A1 explains how these components work.

A3 in [0003] states that the vessel has conduits allowing transfer of water between the sea and the compartment which may be made via a hydroelectric energy conversion module which is for storing energy. This module holds a pump driven by an electric motor and a turbine driving a generator. It therefore contains all the necessary components for hydroelectrical energy storage, so A3 discloses an underwater energy storage device.

a reservoir, a structure providing buckling resistance thereto

A1 [0002] final sentence defines a reservoir as a compartment surrounded by a wall and where water can be let in and pumped out.

In A3, the vessel is an upright cylinder having double walls, see [0002] of A3, so it is a compartment surrounded by a wall. According to A3 [0003], water can be transferred between the sea and the compartment. A3 therefore discloses a reservoir.

A3 [0002] states that the cylinder is buckling resistant due to the double walls. According to [0004] of A1, buckling resistance may be provided by the wall of the reservoir. [0014] of A1 also confirms that a wall can be a structure providing buckling resistance. A3 therefore discloses a reservoir and a structure providing buckling resistance to the reservoir.

anti-buoyancy means having a ballast body with holding means, and spacers made from an elastomer…said spacers are arranged between the

reservoir and the anti-buoyancy means

Per A1 [0005], the purpose of the anti-buoyancy means is to prevent the device from rising when water is pumped out of the compartment due to the buoyancy force.

In A3 [0004], the vessels are arranged on pedestals. According to A3 [0005], there the device also included a roof plate and retaining connectors coupled to the pedestal, as also seen in Figures 2 and 3. The pedestal must be of sufficient weight to prevent the vessel from rising. This system is therefore an anti-buoyancy means.

The pedestal equates to the ballast body, as it provides a downward force in the same way as A1 [0009]. The roof plate and connectors are holding means as they will hold the reservoir in place. The same applies to the rim and straight sections in the second embodiment in Figure 3 and [0007] of A3.

A second embodiment in A3 [0007] onwards has all the features of the first. It includes bumpers 36 mounted on the pedestals, see [0008] of A3. These are mounted on the pedestal inside the straight sections which form part of the holding means, so they are in between the reservoir and anti-buoyancy means. This can be seen from Figure 3.

Per [0010] of A3, the bumpers may be made of an elastomer. The purpose is to reduces the impact due to currents pushing the vessel. This is the same purpose as the spacers in A1 [0011], so the bumpers in A3 equate to spacers. The elastomer is disclosed in combination with an enlarged pedestal, which is covered by claim 1.

All these features of claim 1 are therefore disclosed in A3.

said reservoir has a protrusion along its external surface

A3 [0002] states that the YT-1300 model has a bulge 12 on its outer circumference, which equates to a protrusion on the external surface as evidenced by Figure 1 of A3.

said holding means releasably engages with the protrusion so that the weight of the ballast body is conveyed to the reservoir

In the second embodiment in A3 Figure 3 and [0007], the bulge (=protrusion) interacts with the rim sections which form part of the holding means as discussed above. According to A3 [0009], the rim sections clamp the bulge, and the straight sections are movable to aid extraction. This therefore describes releasable engagement, as the rim sections can engage and then disengage with the protrusion. The effect is that the weight of the ballast body is conveyed to the reservoir, as described in A3 [0005] in which the weight of the pedestal (=ballast body) which is attached to the holding means is conveyed to the vessel (=reservoir).

A3 therefore discloses all the features of claim 1, so claim 1 lacks novelty (Art 54(2) EPC).

Claim 2:

The problem solution approach is applied.

A3 is the closest prior art, as it is directed to the same purpose as claim 2, namely to provide an underwater energy storage device. More specifically, the YT-1300 embodiment of A3 (Fig 3) with the enlarged pedestal per [0006] and [0010] is the closest prior art as it provides the rim/protrusion and the elastomer bumpers, so has the most structural features in common.

A3 [0009] also states that the holding structure is suitable for use at mesopelagic depths, which are depths of 200m to 1000m below sea level according to A2, first paragraph on page 3. Although the YT-1300 model is not suitable for use at such depths, A3 does relate generally to the problem of trying to provide use at depths greater than 200m below sea level which is the same purpose as claim 2. A3 also has the most structural features in common with claim 2, as evidenced by the analysis of claim 1 above.

A3 discloses all the features of claim 1 as discussed above.

A3 also discloses that the reservoir comprises a wall surrounding a compartment. According to [0003] of A3, the vessel (reservoir) has a compartment surrounded by double walls.

There are therefore two differences between A3 and claim 2, which are:

(i) the first reinforcing arrangement inside the compartment extending between opposite sides of the wall, and

(ii) the second reinforcing arrangement in the anti-buoyancy means, extending as a skeleton within the ballast body.

The effect of said differences are as follows:

(i) per [0014] of A1, the use of the reinforcing arrangement in the reservoir allows the usage of the reservoir to be extended to depths greater than 200 m below sea level (mesopelagic depths). In contrast, the YT-1300 reservoir in A3 which has the protrusion is not suitable for use at such depths.

(ii) per [0015] and [0016] of A1, the second reinforcing arrangement provides stiffness to the ballast body allowing it to withstand bending strain. This makes it suitable for safe deployment on uneven surfaces where such strain arises.

There are therefore two technical problems to solve starting from the embodiment of A3 in which the YT-1300 model is used:

(i) to provide an underwater energy storage device suitable for use at depths greater than 200m below sea level, and

(ii) to provide an underwater energy storage devices suitable for use on uneven surfaces.

Per Guidelines for Examination G-VII 5.2 and G-VII 6, this is an example of partial problems. There is no technical effect achieved by all of the distinguishing features in combination, but instead a plurality of partial problems independently solved.

In such cases, a different document can be combined with the closest prior art to solve each partial problem.

Problem (i) is obvious with regard to A6.

A3 [0011] already teaches that the preferred YT-1300 embodiment is not suitable for use at mesopelagic depths, so the skilled person is

motivated to try and modify it to solve the problem. The skilled person knows from [0009] of A1 that the releasable holding means is compatible with mesopelagic depths, so would look at how to modify the YT-1300 vessel to achieve the buckling resistance needed to work at mesopelagic depths.

The skilled person would look at A6 as it also relates to underwater energy storage devices, see [0002] of A6. A6 [0011] also relates to a structure recommended at mesophelagic depths, so aims to solve the technical problem.

A6 [0008] and [0009] describes an embodiment having a reinforcing bundle of pipes which fit into the reservoir. They fit tightly, so will extend between opposing parts of the wall of the reservoir, as confirmed by Fig 4 of A6. According to [0009] of A6, these pipes provide an internal scaffolding which can reduce buckling resistance of the walls of the reservoir. The pipes have the same effect as the coarse gravel in [0005] of A6, which is also to reduce mechanical stress.

As a result, this second embodiment has high buckling resistance making it suitable for use at mesopelagic (greater than 200m) depths. Therefore, the missing features of claim 2 with regard to problem (i) are disclosed in A6.

The skilled person would therefore apply the reinforcing bundle of pipes into the YT-1300 vessel in A3 to create a reservoir having the first reinforcing arrangement. A6 [0010] states the concept can improve buckling resistance of any previously manufactured reservoir, in particular cylindrical reservoirs, so the skilled person understands it will be compatible with the cylindrical vessel of A3. A6 [0008] states that water can rise and fall freely when due to the pipes being open, so the function of the device in A3 will not be impaired. No further modifications are required to make the combination.

Problem (i) is therefore obvious over A3 combined with A6.

Problem (ii) is obvious with regard to A4, which is full prior art for claim 2 as noted above.

A3 [0006] already teaches that the ballast body (pedestal) requires additional measures to be used to resist the strain caused by uneven seabeds when an enlarged pedestal is used, so the skilled person is motivated to modify the pedestal to render it suitable for use on uneven seabeds.

A4 also relates to a device for storing electric energy underwater, see A4 [0001], so the skilled person would consult it as it is in the same technical field.

A4 in Fig 2 and [0006] teaches an embodiment where a reservoir is mounted on a ballast pad (which equates to a ballast body of claim 1) with a restraining structure. [0010] of A4 discloses an embodiment where the body of the ballast pad has a stiff mesh of steel bars in the body of the ballast pad. This mesh equates to a second reinforcing arrangement extending as a skeleton within the ballast body, as [0015] of A1 describes the second arrangement as being a mesh extending within the ballast body. A4 therefore discloses the missing feature of claim 2 with regard to problem 2.

A4 [0011] teaches that the mesh design allows the ballast pad to withstand the strain caused by resting on an uneven seabed. This is therefore the solution to problem (ii). The skilled person would apply the mesh embodiment to the pedestal of A3 to make the device of A3 suitable for use on uneven seabeds.

There is no incompatibility as the skilled person could easily apply the mesh of A6 into the pedestal of A3. In A6 [0010] the mesh applied to concrete, and claim 2 of A3 discloses that the pedestal can be made of concrete, so the skilled person could easily apply the mesh into the pedestal or A2.

[0015] of A1 confirms that a mesh in a concrete body provides the necessary reinforcement.

[0010] of A6 discloses that the ballast pad works at mesopelagic depths (below 200m), so the this requirement of claim 2 is met by the combination.

Problems (i) and (ii) are obviously solved by combining A3 with A6 and A4. Each modification relates to a different part of the device, so no further modifications are needed to combine the solutions. Claim 2 therefore lacks inventive step, Art 56 EPC.

Claim 3:

Claim 3 lacks novelty over A3.

A3 discloses all the features of claim 1 as discussed above.

As evidenced by Figure 3 and [0007], A3 discloses an embodiment having the features of claim 1 in a system where a plurality of devices are used. The embodiment in A3 [0006] has several vessels on an enlarged pedestal to provide connected devices. A3 [0007] and [0010] confirm that this arrangement also applies to the second embodiment having the rim and elastomer bumpers.

In [0006] of A3, a common hydroelectric energy conversion module is used so that the conduits of each vessel feed into the common module. According to [0003] of A3, the energy conversion module includes a pump driven by an electric motor for storing energy and a turbine driving a generator for releasing energy. It follows that conversion to a common hydroelectric energy conversion model means that each device will be connected to a common pump and common turbine, which is the requirement of claim 3.

A3 therefore discloses all the features of claim 3, so claim 3 lacks novelty (Art 54(2) EPC).

Paper C part 2

This represents a continuation of part 1 so the opposition details are as provided in part 1.

In addition to the grounds provided at the start of part 1, A1 is also opposed on the ground of added subject matter under Art 100(c) EPC.

The facts and evidence for claims 4-6 are set out below.

Effective dates of the claims

Claims 4 and 5 were present in the second priority document, NO20150000355 ('P2'). They were not present in the first priority document, NO20150000355 ('P1').

The embodiments in claims 4 and 5 are described in Figure 5 and in paragraph [018] onwards, which were not present in P1. There is no basis in P1 for these claims, so their effective date is that of P2, 10 June 2015.

Claim 6 itself was not present in either priority document or the application as filed. Claim 6 may be divided first into two embodiments:

Claim 6(1) - when dependent on claim 1; and

Claim 6(5) - when dependent on claim 5.

When dependent on claim 1, there is no basis in the application as filed, so claim 6(1) adds matter as discussed below and has no effective date.

The claim may be subdivided into two further parts which may be entitled to separate priorty dates, as per partial priority decision G1/15:

Claim 6(5)(i) - having 17-23% by weight RZCH

Claim 6(5)(ii) - having 23-35% by weight RZCH.

(this division also applies to claim 6(1), but is not necessary to discuss here)

Claim 6(5)(i) is disclosed in [0022] of A1 which discloses the range of 17-23% for the embodiment in claim 5. This was present in P2 but not P1, so claim 6(5)(i) is entitled to an effective date of 10 June 2015.

Claim 6(5)(ii) only has basis in [0023] of A1, which was added to the application as filed, so was not present in P1 or P2. There is no other disclosure in the application of 23-35% RZCH for the sealing layer.Claim 6(5)(ii) is therefore entitled to the filing date of A1, 5 March 2016.

Added matter:

As noted above, claim 6 can be divided into claim 6(1) and claim 6(5). Claim 6(1) adds matter because it has no basis in the application as filed and was added during prosecution.

The only disclosure of the relevant RZCH ranges are in [0022] and [0023], which provides the ranges of. In both these cases, the range is disclosed only in combination with the sealing layer and features of claim 5, see the first sentence of each paragraph. These cannot therefore provide basis for a dependency on claim 1, as in claim 5 the elastomer relates to the sealing layer and not the spacers.

[0011] of A1 discloses that the elastomer may contain 13 to 47% RZCH. This is broader than the claimed 17-35%, so paragraph [0011] cannot provide basis for claim 6. It is not possible to combine paragraphs [0011] and [0022]/[0023] as they relate to different embodiments (the spacer vs the sealing layer as discussed above). There is therefore no basis for the spacers in claim 1 to have elastomers of 17-35% RZCH, so claim 6(1) adds matter in contravention of Art 123(2) EPC.

Prior art:

A2 itself was published 6 August 2015, which is before the filing date of A1 but after both priority dates. A2 itself is therefore prior art for novelty and inventive step for claim 6(5)(ii) under Art 54(2) EPC.

A2 also notes that in the last week of May, an assembly took place which was visible to spectators on tourist barges and which demonstrated the assembly of Figure 1 of A2.

This represents a public prior use. Per GL G-IV 7.2, the use took place in the last week of May. What was used was the assembly of the components shown in Figure 1 of A2. The circumstances are that the assembly was visible to spectators on tourist barges, who would be members of the public.

Per GL G-IV 7.2.1, there was no bar on confidentiality, so all knowledge that could be gained from external examination of the pieces being assembled has been made available to the public. Persons with technical knowledge to understand the disclosure could have been on barge so could have seen the disclosure.

This disclosure was made in May 2015, so between P1 and P2 of A1. This disclosure, which I will refer to as 'A2-use' in future, represents prior art under Art 54(2) EPC for claims 4-6 so is available for novelty and inventive step.

A3, A5 and A6 were all published before the first priority date of A1, so are prior art under Art 54(2) EPC and available for novelty and inventive step of claims 4-6.

A4 was published 6 April 2015, which is between P1 and P2 of A1. It is therefore prior art under Art 54(2) EPC and available for novelty and inventive step of claims 4-6.

Novelty and inventive step:

Claim 4:

Claim 4 lacks novelty over A5, because A5 discloses the features of claim 4 as follows:

An underwater energy storage device comprising a reservoir, a structure providing buckling resistance thereto, and anti-buoyancy means

A5 discloses an underwater energy storage device, as [0001] of A5 relates to underwater storing tanks for storing energy in fossil form, e.g. petroleum. [0008] of A5 confirms that the tank of A5 can store petroleum, meaning that it is a storage device for energy in fossil form.

A5 disloses a tank, e.g. in [0002], which is a reservoir as per [0002] of A1 as it is a compartment surrounded by a wall and water can be pumped

in and let out. [0009] confirms that water can be let in and out. Even if A5 doesn't disclose pumping water specifically, water still could be pumped in using the valve in [0008], so the device is a reservoir.

[0010] of A5 states that the walls were not built to resist forces from hydrostatic pressure. However, the device comprises a membrane partition in [0008]. This works by ensuring that water flows in from the sea when the compartment is not filled with the fluid, and flows out again when fluid is added. The result per [0010] is that the tank won't collapse from outside hydrostatic pressure. The internal membrane is therefore a structure which provides buckling resistance to the reservoir. [0004] of A1 confirms that providing buckling resistance means that the device won't collapse when water is pumped out, so the membrane in A5 meets this requirement.

A5 [0003] states that the weight of the concrete compensates for buoyancy when filled with a fluid lighter than water. This meets the definition in A1 [0005] of an anti-buoyancy means as it will ensure the device does not rise when water is pumped out.

said reservoir has been formed by joining several mid-piece reservoir sections and two end reservoir sections

It is clear from [0002] of A5 and Figure 1a that the reservoir is formed of several pipe sections 12 in the middle (so mid-pieces) and two end sections 11.

said reservoir sections are provided with tensioning tubes through which wire ropes are strung

A5 [0004] and Figure 1b show that the pipe sections have boreholes and that wire ropes are provided that are strung through these sections. A1 [0019] states that a tensioning tube may be a borehole, so a tensioning tube is disclosed in A5, and the wires in A5 are strung through this tube.

said wire ropes comprise strands of twisted metallic wires, the number of strands being 7 or fewer

A5 [0005] states that the wire ropes are of type PI-R. According to the footnote at the end of A2, PI-R ropes have 7 strands or fewer of twisted metallic wires, so the ropes of A5 fall within the requirement of claim 4.

Claim 4 therefore lacks novelty over A5, Art 54(2) EPC.

Claim 5:

Claim 5 lacks inventive step.

A4 is the closest prior art. It relates to the same purpose as claim 5, which is to provide a device for underwater hydroelectric energy storage. It also requires a minimum of structural modifications to arrive at the invention.

For completeness, it is noted that the purpose of A5 is not related to hydroelectric energy storage as it stores fossil fuels. Additionally, A2-use did not include the hydroelectric energy module in the visual disclosure, and is also missing disclosure of structural features as it was not possible for the spectators to tell e.g. what the ropes were made of. A3 and A6 would require more structural modifications so are less promising.

A4 discloses most of the features of claim 5 as follows:

An underwater energy storage device comprising a reservoir, a structure providing buckling resistance thereto, and anti-buoyancy means

A4 relates to an underwater energy storage device, see [0001]. It includes a reservoir which is resistant to buckling due to the double wall with concrete, as disclosed in A4 [0003]. The device has a restraining structure 26 which acts as an anti-buoyancy means, see A4 [0009].

said reservoir has been formed by joining several mid-piece reservoir sections and two end reservoir sections

The reservoir in A4 is made of adjacent pipe segments which are connected along with end segements to form a modular reservoir, see [0003]. This is confirmed in Figure 2.

said reservoir sections are provided with tensioning tubes through which wire ropes are strung

This feature is not disclosed.

said wire ropes comprise strands of twisted metallic wires, the number of strands being 7 or fewer.

This feature is not disclosed. There are ropes in [0009] but these are not in tensioning tubes and are PI-F so have more than seven strands.

A device according to claim 4, wherein said reservoir has been formed so that adjacent reservoir sections are joined with a sealing layer between them, said sealing layer comprising an elastomer

A4 [0004] teaches that a gasket made from an elastomer may be used to form a watertight connection between the adjacent sections. This is the same as in A1 [0022] where the elastomer provides a watertight joint, so A4 discloses this feature.

said reservoir is connected, for the purpose of storing energy, to a pump driven by an electric motor and connected, for the purpose of releasing energy, to a turbine driving a generator.

A4 [0006] discloses an integrated hydroelectric energy conversion module containing the electromechanical components necessary for underwater hydroelectric energy storage. According to A1 [0002], these necessary components are the electric motor, pump, turbine and generator, and they work by the pump driving the motor to store energy and the tubrine driving the generator to release energy, as in A1 [0005]. A1 [0002] confirms this concept is well known. As A4 discloses the necessary components, these must implicitly include those found in this feature of claim 5.

The difference between A4 and claim 5, as noted above, is therefore that the reservoir is provided with tensioning tubes through which wire ropes having 7 or fewer twisted metallic wires are strung.

The effect of this difference, per A1 [0019]-[0021], is that the wire ropes are protected from outside damage so the reservoir has a longer service period.

The objective technical problem to be solved is therefore to provide an underwater energy storage device which is more protected from damage and therefore has a longer service period.

The problem is solved in an obvious manner by looking at A5.

A5 also relates to underwater energy storage tanks, so is in the same field and the skilled person would consider it.

A5 discloses the missing features of the wire ropes as discussed under the novelty attack on claim 4 above.

A5 [0007] teaches that an advantage of the wire rope rigging is that the ropes are shielded from external damage, so a long service period is expected. This is the same problem as discussed above, so the skilled person would implement a wire rope rigging system in A4 to solve the problem.

A4 [0005] already teaches that the screws may be damaged by the environment and that other tensioning methods may be used, so the skilled person is motivated to look for another tensioning method. A5 discloses such an alternative method.

A5 [0012] teaches that the reservoir may have a trapezoidal cross section which is the same shape as A4 (see e.g. A4 [0002]), so the skilled person understands they are compatible. The skilled person could easily insert the wires into the modular assembly in A4, so no further modification is required.

When implementing the wire rigging in A5, the skilled person would choose the PI-R ropes disclosed in A5 [0005] as it is taught that these are sufficient. As discussed above under the novelty attack on claim 4, these ropes fall within claim 4.

Claim 5 therefore lacks inventive step over A4 combined with A5, Art 56 EPC.

Claim 6:

As noted earlier, claim 6(1) adds matter.

Claim 6(5)(i)

Claim 6(5)(i), having 17-23% by weight RZCH as the elastomer sealing layer, lacks inventive step over A4 in combination with A5.

A4 in [0004] discloses that the elastomer which forms the seal should have at least 10% by weight RZCH, but should be 20% or less to achieve a watertight seal. Per Guidelines G-VI(iii), novelty is destroyed by an explicitly mentioned end point of the known range, so the disclosure of 20% RZCH falls within the range of 17-23% in claim 6.

A4 therefore discloses the additional feature in claim 6(5)(i) as compared to claim 5, so claim 6 lacks inventive step over A4 in combination with A5 for the same reasons as discussed above under claim 5.

Claim 6(5)(ii)

Claim 6(5)(ii) lacks inventive step. The written magazine excerpt in A2 is now available due to the loss of partial priority for this part of claim 6, and is the closest prior art. This is because it relates to the same purpose, namely to provide an underwater energy storage device, and discloses all of the features of claims 4 and 5. It is therefore the most promising starting point as it requires the least number of structural modifications as compared to the other available documents.

A2 discloses the features of claims 4 and 5 as follows:

An underwater energy storage device comprising a reservoir, a structure providing buckling resistance thereto, and anti-buoyancy means

The second paragraph on page 2 of A2 (lines 4-10) discloses a hydroelectric power plant for the deep sea which is used to store energy, so it is an underwater energy storage device.

The device is a reservoir, see A2 page 3 line 20. The reservoir has a double steel wall and honeycomb structure to provide buckling resistance, see A2 page 4 lines 1-5.

A2 page 2 line 25 states that a sturdy tank acts as a ballast structure, which is a known anti-buoyancy means according to A1 [0005]. A2 page 4 lines 8-11 discloses that the reservoir has skirts which can be filled with gravel to keep the plant on the seabed when empty, so the device has an anti-buoyancy means as defined in A1 [0005].

said reservoir has been formed by joining several mid-piece reservoir sections and two end reservoir sections

A2 page 3 lines 13-20 describe assembly of several sections to make a reservoir. It is evident from Figures 1 and 3 that the reservoir has two end sections, similar to Fig 5 of A1.

said reservoir sections are provided with tensioning tubes through which wire ropes are strung

The assembly in A2 page 3 lines 13-18 involves assembly with wire ropes. It is clear from A2 page 1 lines 4-5 that the wire ropes are strung through duct tunnels, which are tensioning tubes as evidenced by A1 [0019]. Duct channels are also disclosed in A2 page 4 lines 4-5, which says the channels are for the ropes. This feature is therefore disclosed.

said wire ropes comprise strands of twisted metallic wires, the number of strands being 7 or fewer

A2 page 4 lines 13-15 states that PI-R wire ropes are used. As per the footnote, these comprise seven or fewer stands of twisted metallic wires.

A device according to claim 4, wherein said reservoir has been formed so that adjacent reservoir sections are joined with a sealing layer between them, said sealing layer comprising an elastomer

In A2 page 3 lines 17-18, a sealing layer is used between the neigbouring segments, meaning that the adjacent segments are joined by a sealing layer. A2 page 4 lines 15-16 then states that the sealing layers are made from elastomer comprising RZCH.

said reservoir is connected, for the purpose of storing energy, to a pump driven by an electric motor and connected, for the purpose of releasing energy, to a turbine driving a generator.

A2 page 3 lines 20-23 states that there is a hole and a hydroelectric energy conversion module is connected. The concept is disclosed in A2 page 2 lines 4-10 and includes using electric energy to pump water out to store energy, so there will be a pump driven by an electric motor. A turbine-generator is then driven to recover the energy. This also correponds with the features and mechanism in A1 [0002] and [0003]. A2 therefore discloses this feature.

The difference between A2 and claim 6 is therefore the additional features of claim 6. In the case of claim 6(5)(ii), the difference is specifically the RZCH elastomer having 23-35% by weight. In A2, RZCH is disclosed, but the % by weight is not.

The effect of this difference, per A1 [0023], is that a higher RZCH weight content prolongs the service period at higher depths by providing long term stability against deformation. Unlike in A4 [0004], a higher weight is acceptable at lower depths as the increased pressure allows greater rigidity.

The technical problem is therefore to provide an underwater energy storage device having improved long term stability at higher depths leading to a prolonged service period.

The skilled person would solve this problem by turning to A6.

A2 discloses RZCH but does not provide the % weight, so the skilled person will have to find a suitable weight to use and be motivated to try and look for a suitable weight. A2 also relates to deep sea power plants, see page 2 line 4, and page 2 line 4 also states they store more energy. The skilled person is therefore motivated to make a device which hasimproved stability in deep sea conditions.

A6 also relates to a device for use in underwater hydroelectric storage, see [0002], so it relates to the same purpose and the skilled person would consult it.

A6 [0012] discloses that at mesopelagic depths, higher amounts of RZCH can be used in the sealing layer than at epipelagic depths due to the pressure. Mesopelagic depths are deeper areas, as per A2 page 3 lines 1-4.

A6 [0012] then discloses that using higher amounts of RZCH leads to improved long term stability against deformation meaning that the reservoir remains in service for longer, so A6 relates to the technical problem defined above. The skilled person is therefore motivated to apply this concept to A2 to solve the problem.

A6 [0012] discloses the specific value of 30% by weight RZCH, which anticipates the range of 23-35% by weight RZCH in claim 6(5)(ii). The skilled person would therefore use 30% when implementing the concept of A6 in A2, and would arrive at claim 6(5)(ii).

No further modification is needed, as A2 uses an RZCH layer to ensure stability so the skilled person would simply make this layer 30% by weight.

Claim 6(5)(ii) is therefore obvious in view of A2 combined with A6, so claim 6 lacks inventive step (Art 56 EPC).