

## **Underwater rapid unloading system**

The invention relates to an underwater rapid unloading system comprising a container which can be carried on the outer side of a submarine and which has a carrier frame which is supported inside the container and a disposable palette which can be fitted to the carrier frame.

Storage containers are often fitted to the outer side of submarines for underwater operations. Divers can leave the submarine in the submerged state and can remove equipment from the storage container. In this instance, it is important that a diver, on the one hand, quickly gains access to his equipment in order not to unnecessarily use up diving time and oxygen which is then unavailable to him during actual use. On the other hand, the storage container must be constructed in such a manner that a diver with motor capabilities which are restricted under water can also readily open the storage container and can remove the contents.

DE 10 2007 041 724 A1 discloses containers which can be carried on the outer side of a submarine and which have a carrier frame which is supported inside the container.

Not only do divers normally remove individual components of the equipment from the container, but the container also contains the equipment which is necessary for use and which then has to be completely removed as quickly and efficiently as possible. Generally, the equipment has to be brought to the surface of the water after removal. This can be carried out, for example, by means of lifting bags or buoyancy members. In this instance, the problem is that the load is also intended to be transported to the surface of the water in a manner as coherent as possible with a very non-uniform weight distribution.

An object of the invention is to provide an underwater rapid unloading system with which equipment from a container which is fitted to the outer side of a submerged submarine can be removed quickly and reliably.

The object is achieved by the underwater rapid unloading system having the features set out in claim 1 and by a disposable palette for an underwater rapid unloading system having the features set out in claim 14. Advantageous developments will be appreciated from the dependent claims, the following description and the drawings.

The underwater rapid unloading system according to the invention comprises a container which can be carried on the outer side of a submarine. A carrier frame is supported inside the container. A disposable palette is arranged on the carrier frame and the disposable palette can be connected to the carrier frame.

As a result of the disposable palette according to the invention, the load stored in the container can be rapidly and readily unloaded under water even if comparatively large or heavy loads are arranged on the disposable palette.

A carrier frame which can be deployed after a container cover is opened is provided inside the container which is provided in order to fix objects to the outer side of a submarine and to carry objects under water. The objects which are intended to be stored inside the container are advantageously fixed to the carrier frame via the disposable palette, whether this be in that the carrier frame comprises corresponding side walls which retain the objects and/or the disposable palette or the objects and/or the disposable palette are connected to the carrier frame, for example, via lashing straps or other connection means so that the container interior does not have to be accessible in order to load and unload the carrier frame but instead the carrier frame can be deployed from the container after the cover has been opened so that the objects can be unloaded comfortably with the disposable palette from the sides of the carrier frame. The carrier frame is preferably constructed in such a manner that repeated loading is also possible under water without a disposable palette. Practically any narrow and elongate containers can be loaded and unloaded in a simple and reliable manner because it is no longer necessary to reach inside or even to climb inside the container, but instead it is readily accessible after the carrier frame has been deployed and it can be loaded or unloaded from a safe position. Furthermore, the unloading is carried out quickly and reliably by using the disposable palette.

In principle, the container can also be flowed through, that is to say, the interior of the container communicates with the environmental pressure. The container is particularly advantageously constructed in a pressure-resistant manner. The container substantially has to withstand the same submersion pressure as the submarine. Such a pressure-resistant, hermetically closed container has the great advantage that the objects supported therein are not subjected to a constant pressure change and in particular the advantage over containers subjected to free throughflow that the objects located therein are not exposed to the aggressive salt water. The container can also be supported as a whole in a shock-resistant manner so that it is substantially possible to dispense with a corresponding support inside the container.

As a result of the necessary pressure resistance, the construction variants are comparatively small with regard to the container form. It is particularly favourable if the container has a substantially cylindrical form which extends parallel with the submarine, wherein only a cover which is preferably arranged at the bow side (at the front when viewed in the travel direction of the submarine) is advantageously provided at the end side because the rear side of the container can then be covered in a streamlined manner.

The container is advantageously constructed in such a manner that it comprises a smooth outer skin. In this case, at least the pressure-resistant portion of the container is constructed similarly to the pressure member of a submarine, that is to say, in a state supported by a large number of internal ribs. The rear end side is advantageously constructed to be closed, whereas the front end side is constructed to be open and able to be closed by the cover. As a result of such a construction, a streamlined container having a comparatively large storage space which can be effectively used is obtained with comparatively small outer dimensions. The storage space can be used particularly well in particular since there is provided the carrier frame which receives the objects to be stored and which can be deployed completely out of the container interior for loading and unloading. To this end, the carrier frame is advantageously supported in a telescope-like manner.

In order to deploy and retract the carrier frame which may have a substantial weight with the objects located thereon, a drive can be provided. The drive can be supported by auxiliary means, for example, compressed air, but advantageously it is constructed in such a manner that it can be actuated exclusively by manual force.

In order to achieve an ability to deploy the carrier frame as completely as possible, it is advantageously supported in a displaceable manner on a bogie which is in turn arranged in a displaceable manner on a bearing frame which is secured at the container side. With such an arrangement, a reliable retention of the carrier frame inside the container is also ensured in the completely deployed position of the carrier frame because approximately half of the travel path is produced by the bogie and the other half of the travel path is produced by the actual carrier frame so that sufficient portions of the above-mentioned components with which they can be retained at the container side always remain.

The drive for deploying and retracting the carrier frame is advantageously formed by at least one spindle drive which can preferably be actuated from outside the container by means of a hand crank. Such a spindle drive has the advantage that it is robust, on the one hand, and can receive great forces and, on the other hand, it is self-locking so that it is ensured in each spindle position that the carrier frame and bogie are fixed in relation to the container and cannot, for example, be deployed or retracted independently as a result of an inclined position. In this instance, the spindle drive may be configured so that it can advantageously be actuated by the diver by a hand crank and, where applicable, a step-down gear must be provided in order to be able to apply the forces necessary for deployment and retraction by hand. In order to allow deployment by hand for a diver, the necessary force for using the spindle drive should not exceed 200 N. In this case, it should be taken into account that the load may not be distributed uniformly on the disposable palette and consequently on the carrier frame. Furthermore, the number of rotations of the spindle drive should be limited to 40 rotations because a diver otherwise uses too much force and time and consequently also oxygen from the air supply in order to unload the load from the container in readiness for actual use.

There are advantageously provided two spindle drives, a first spindle drive between the bearing frame or container and the bogie, and a second one between the bogie and carrier frame. Both spindle drives are configured in such a manner that they can be actuated by means of a hand crank, respectively, wherein a hand crank which is arranged near the front end of the bogie directed toward the container opening is preferably provided in order to actuate the first spindle drive and a hand crank which is arranged near the front end of the carrier frame directed toward the container opening is preferably provided in order to actuate the second spindle drive. This may involve a hand crank which is arranged so as to be able to be changed over and non-releasable. In such an arrangement, initially the spindle drive arranged between the bearing frame and the bogie is actuated in order to deploy the carrier frame until the bogie is deployed to a maximum extent, after which the spindle drive between the bogie and the carrier frame is deployed. During retraction, the procedure is in the transposed sequence.

The bearing frame, bogie and carrier frame are advantageously arranged at the lower side of the container in such a manner that the spindle drives can be arranged in the free space formed between the carrier frame and bearing frame inside the bogie so that a free space which is as large as possible and which is produced above the carrier frame is formed to receive loads.

In principle, the container according to the invention is configured with a pressure-resistant construction so that the objects located therein are stored in a hermetically closed manner in an atmosphere of air or protective gas. In order to be able to open the container under water, it is first necessary to ensure pressure equalisation. Advantageously, however, the container is flooded almost completely before the carrier frame is opened and deployed because then a reliable and simultaneously simple handling of the carrier frame with the objects located therein is ensured under water. To this end, there are provided according to the invention two valves, that is to say, a valve for flooding with an inlet at the lower side of the container and a valve for venting with an outlet at the upper side of the container.

The cover which closes the container at the end side is advantageously supported on the container in a pivotable manner, wherein a gear mechanism which is operated with a hand crank and with

which the cover can be pivoted open or closed under water can be provided for pivoting. This drive is also advantageously constructed to be self-locking so that the cover remains fixed in each position without there being any risk of swinging open or closed.

The cover is advantageously provided with at least one bolt which fixes the cover to the container in the closed position in a positive-locking manner. Advantageously, there are provided a large number of bolts which are distributed over the periphery of the cover and which can be controlled via an actuation mechanism which is arranged at the inner side of the cover. The actuation mechanism comprises a shaft which extends through the cover in a pressure-tight manner and on which a handle which is intended to be actuated from the outer side is located in a rotationally secure manner so that the locking can be released or can be locked internally by means of the handle from the outer side. There may be provided as the handle a hand wheel but preferably a manual lever which displaces, for example, the bolts from the locked position to the unlocked position, or vice versa, after pivoting through from 30° to 60°.

The disposable palette can be connected to the carrier frame. Preferably, the disposable palette is fixed on the carrier frame by means of locks. The locks are preferably constructed as click-fit locks. Preferably, two locks are located at the front side of the carrier frame and the disposable palette.

In another embodiment of the invention, the carrier frame can be completely deployed out of the container. In order to be able to introduce the disposable palette with the load efficiently into the container and to move it out, the carrier frame can be completely deployed out of the container. For loading, for example, above water, the disposable palette with the load can then be lifted onto the carrier frame by a crane in a horizontal position of the disposable palette. The load is thereby prevented from being displaced on the disposable palette.

It is also advantageous when the load is moved out on the disposable palette for the carrier frame to be able to be deployed completely. Although a diver has to deploy the carrier frame to this end, which costs valuable diving time, the disposable palette can be removed and in particular brought

to the surface of the water in a horizontal position and consequently without any risk of displacement of the load.

In another embodiment of the invention, the disposable palette can be connected to the carrier frame via at least two locks. The two locks are preferably click-fit locks. The advantage of the click-fit locks is that they can be unlocked comparatively simply by a diver and can nevertheless connect the disposable palette to the carrier frame in a shock-resistant manner. Advantageously, the two locks are arranged at the front side of the carrier frame.

In another embodiment of the invention, the disposable palette comprises a buoyancy system.

In another embodiment of the invention, the buoyancy system comprises at least a first inflatable buoyancy member. This embodiment has the advantage that the disposable palette can be removed from the carrier frame and brought to the surface of the water in a particularly rapid, safe and reliable manner. In that the disposable palette comprises a buoyancy system and the buoyancy system comprises at least one buoyancy member, the disposable palette is lifted with the load fixed on the disposable palette as a whole during the outward movement action. The load can thereby be brought from the container to the surface rapidly and together. Furthermore, individual objects, if they were to be individually brought to the surface of the water with separate buoyancy members, are thereby prevented from being able to drift away as a result of a current.

In another embodiment, the disposable palette and the at least one first inflatable buoyancy member form an inflatable boat.

In another embodiment of the invention, the buoyancy system comprises, in addition to the at least one first inflatable buoyancy member, at least a second inflatable buoyancy member. Furthermore, the buoyancy system comprises a device for distributing gas from a gas supply to the at least one first inflatable buoyancy member and the at least one second inflatable buoyancy member. The device for distributing gas may comprise, for example, hoses and/or pipes.

Furthermore, the device for distributing gas may comprise taps, in particular two-way taps or three-way taps, and valves, in particular non-return valves or overpressure valves.

The palette can be fixed to the deployment table by ropes. An advantage is that the palette does not then immediately rise but instead an adjustment or counterbalancing of the buoyancy members can first be carried out. Subsequently, the ropes are then released or cut.

In another embodiment of the invention, the gas supply comprises a compressed air connection. A diver can feed in compressed air from the breathing apparatus of the diver via this compressed air connection. Alternatively, the diver can carry a compressed air bottle for connection to the underwater rapid unloading system. As a result of the supply of the compressed air by the diver, the underwater rapid unloading system can be simply constructed and is particularly less susceptible to the effects of impacts.

Alternatively, the gas supply comprises a compressed gas bottle, wherein the compressed gas bottle is connected to the disposable palette. An advantage of this embodiment is that the breathing air of the diver is not used up or the diver does not have to carry additional compressed air. The diver is thereby more flexible and is impeded less in the actual mission.

In an alternative embodiment, the gas supply comprises a device for producing gas. Preferably, the device for producing gas is a pyrotechnic gas generator. For example, the pyrotechnic gas generator comprises sodium azide as a solid propellant. Such systems are known from the field of airbags and have been found to be advantageous. An advantage of this embodiment is that no compressed gas has to be carried on the disposable palette. The underwater rapid unloading system can thereby be constructed more easily in an impact-resistant manner. In addition, solid propellant is very much more compact than compressed gas and does not require any heavy pressure containers so that very much more space remains for the useful load on the disposable palette.

For example, four inflatable buoyancy members are located at four corners of the disposable palette in order to produce a uniform buoyancy for the disposable palette. Those four buoyancy members are connected to a gas supply via a pipe system. The gas supply is arranged at the front end of the disposable palette. A diver can connect a compressed gas bottle to the gas supply and thus at the same time inflate simultaneously all four inflatable buoyancy members. In an advantageous manner, flow resistances are fitted in front of the two front buoyancy members so that the flow speed of the compressed air in all four buoyancy members is of identical size and thus the disposable palette is kept horizontal. In the simplest embodiment, such a flow resistance is a pipe of reduced diameter.

In another embodiment of the invention, the device for distributing gas is constructed as an inflatable buoyancy member. For example, the device for distributing gas is constructed as a resilient hose. An advantage of this embodiment is that the buoyancy is produced in a relatively uniform manner. Furthermore, the uniform distribution of the additional buoyancy also results in tilting of the disposable palette becoming more difficult. It is thereby easier to stabilise the disposable palette in the horizontal position.

In another preferred embodiment of the invention, the device for distributing gas is constructed as an inflatable buoyancy member and the device for distributing gas completely surrounds the disposable palette. An advantage of this embodiment is that a buoyancy is produced in a particularly uniform manner and stabilizes the disposable palette in a horizontal state. Furthermore, the buoyancy is thereby produced in a comparatively low position, whereby the disposable palette can be brought particularly close under the surface of the water. In a particularly preferable manner, the buoyancy of the device for distributing gas is configured in such a manner that the buoyancy is sufficient to retain the disposable palette with the load on the surface of the water, that is to say, the displacement (volume) is greater than the total weight of the disposable palette with the load.

In another embodiment of the invention, the buoyancy system comprises a front and a rear region. The buoyancy of the buoyancy system in the front region differs from the buoyancy of the

buoyancy system in the rear region. An advantage of this construction is that very different weight distributions on the palette can be compensated for and the disposable palette can be retained in the horizontal position. A very different weight distribution is produced, for example, if the load contains an inflatable boat with an outboard motor. The region in which the motor is located, conventionally the rear region, requires comparatively more buoyancy as a result of the comparatively great weight of the motor. As a result of the different configuration of the device for distributing gas, more buoyancy can thus be produced in the region in which the motor is located. It is thereby ensured that the disposable palette can be kept horizontal.

In another preferred embodiment of the invention, a control valve or a throughflow limiter is arranged between the front region and the rear region of the device for distributing gas. A diver can thereby counterbalance the disposable palette in order to compensate for weight differences without this disposable palette having been constructed for the precise weight distribution. This increases the flexibility and stability of the system.

In another embodiment of the invention, the buoyancy members of the disposable palette are constructed in such a manner that the buoyancy members lift the disposable palette in such a manner that the disposable palette is lifted off from the carrier frame, wherein the carrier frame is located completely inside the container. This embodiment allows a particularly rapid unloading of the container because the carrier frame no longer has to be deployed from the container. The operating time of the diver for the actual use is thereby maximized. On the other hand, the disadvantages are accepted that the buoyancy members already have to be able to be inflated inside the container. The usable volume in the container for the useful load is thereby reduced. Furthermore, the disposable palette has to be constructed and loaded in such a manner that it is kept precisely in the horizontal position by the buoyancy members being inflated. At this time, an intervention by the diver is hardly possible because both the vision and the capability of the diver for manipulation are very limited as long as the disposable palette is located inside the container. However, these disadvantages are accepted in accordance with the situation in order to increase the operating time of the diver.

In another embodiment of the invention, the disposable palette comprises openings for lashing the load which is intended to be stored on the disposable palette. Preferably, these openings for lashing are arranged at the upper side of the disposable palette and have an elongate profile because straps are normally used for lashing. Therefore, the openings for lashing have a width of preferably from 2 cm to 10 cm, particularly preferably from 4 cm to 8 cm.

In another embodiment of the invention, the disposable palette comprises holes in the bottom of the disposable palette. These holes are used so that water can be introduced through these holes. The disposable palette can thereby sink rapidly and reliably after the buoyancy members have been unloaded and removed. In another embodiment, the bottom of the disposable palette is in the form of a grid or a net.

In another embodiment of the invention, the disposable palette comprises at least one handle. The handle is used to lift the palette onto the carrier frame or to remove it from the carrier frame. In a particularly preferable manner, the at least one handle is arranged in such a manner that it can be gripped from the outer side if the disposable palette is in the container. In a particularly preferable manner, the disposable palette comprises at least two handles which are arranged on the end sides of the disposable palette.

In another embodiment of the invention, the disposable palette comprises lifting lugs. Lifting lugs are foldable eyelets which are usually annular or oval and which can be used to fix ropes or straps. Lifting lugs can be fitted on the outer side of the disposable palette in order to use these lifting lugs, to move the disposable palette by means of a crane, in particular in order to lift the disposable palette onto the carrier frame.

Additionally or alternatively, lifting lugs can be arranged on the inner side of the disposable palette in order to be able to lash in particular small cargo pieces.

The invention further relates to a disposable palette for an underwater rapid unloading system according to the invention. The features of the disposable palette can be taken from the description of the underwater rapid unloading system.

The invention further relates to the use of a disposable palette for an underwater rapid unloading system according to the invention.

The underwater rapid unloading system according to the invention is explained in greater detail below with reference to an embodiment illustrated in the drawings, in which:

Figure 1: is a schematic side view of a submarine having two containers,

Figure 2: is a schematic plan view of a submarine having two containers,

Figure 3: is a schematic enlarged cutout of a submarine having a container as a side view,

Figure 4: is a schematic enlarged cutout of a submarine having a container as a plan view,

Figure 5: is a cross-section through a container having a carrier frame and disposable palette,

Figure 6: shows an embodiment of a disposable palette having four buoyancy members,

Figure 7: shows another embodiment of a disposable palette having a hose-like device for distributing gas,

Figure 8: is a schematic side view of the retention member between the carrier frame and the disposable palette,

Figure 9: is a schematic plan view of the retention member between the carrier frame and the disposable palette.

Figure 1 shows a submarine 10 having two containers 20 which are arranged laterally on the outer hull. Divers can leave the submarine in the submerged state and can remove the equipment stored in the container 20. This is shown in Figure 2 as a plan view by way of illustration.

Figure 3 is a side view of a submarine 10 having a container 20 which is arranged on the submarine 10. Figure 4 is a plan view thereof, wherein the container 20 is opened and the carrier frame 30 is deployed.

Figure 5 is a cross-section through a container 20. A carrier frame 30 which is connected to the outer hull of the container 20 via a deployable frame 32 is located in the container 20. The deployable frame 32 can be deployed with the hand crank 38 and the carrier frame 30 can be deployed with the hand crank 36. Preferably, the hand cranks 36, 38 are constructed in such a manner that they can be operated by a diver under water. Furthermore, the hand cranks 36, 38 are constructed in a foldable manner so that they take up little space in the closed container 20. The deployable frame 32 is constructed in such a manner that the carrier frame 30 can be completely deployed out of the container 20. A disposable palette 40 is fixed on the carrier frame 30 by means of two retention members 34.

Figure 6 shows an embodiment of a disposable palette 40 having four buoyancy members 50, 51, 52, 53. The four buoyancy members 50, 51, 52, 53 are arranged at the corners of the disposable palette 40. They can be inflated at the same time via a device for distributing gas 60. To this end, the device for distributing gas 60 comprises a gas supply 62. A diver can connect his breathing apparatus or an additional compressed gas bottle to the gas supply 62. For easier handling, the disposable palette 40 further comprises a handle 42 which is fitted to the side of the disposable palette 40 which faces the opening of the container 20. Optionally, the handle 42 may be fitted to both end sides of the disposable palette 40.

Advantageously, the four buoyancy members 50, 51, 52, 53 are connected to the device for distributing gas 60 via non-return valves. The gas is thereby prevented from being able to flow from one buoyancy member via the device for distributing gas 60 into another buoyancy member. This could otherwise occur if the disposable palette is no longer horizontal. The buoyancy members which are located at the lower end of the disposable palette 40 would, as a result of the higher hydrostatic pressure, thereby discharge gas to the buoyancy members which are higher and which would thereby produce more buoyancy and would thus further increase an inclined position.

Another embodiment of the disposable palette 40 is shown in Figure 7. Here, the buoyancy members 50, 51 are inflated via the device for distributing gas 60, wherein the device for distributing gas 60 comprises two inflated hoses 64 in addition to a gas inlet 62. These inflated hoses 64 not only serve to distribute the gas but further produce buoyancy.

Figure 8 is a schematic side view of the retention member 34 between the carrier frame 30 and the disposable palette 40. The retention member 34 fixes the disposable palette 40 on the carrier frame 30 and is constructed, as illustrated, in such a manner that it can be readily released by a diver. The hand crank 36, with which the diver has initially deployed the carrier frame 30 from the container 20 which is not shown, can also readily be seen. After the retention member 34 has been released, the diver can remove the disposable palette by means of the handle 42. In order to illustrate the illustration shown in Figure 8, the same device is shown in Figure 9 as a schematic plan view of the retention member 34 between the carrier frame 30 and the disposable palette 40.

Reference numerals:

- 10 Submarine
- 20 Container
- 30 Carrier frame

|    |                             |
|----|-----------------------------|
| 32 | Deployable frame            |
| 34 | Retention member            |
| 36 | Hand crank                  |
| 38 | Hand crank                  |
| 40 | Disposable palette          |
| 42 | Handle                      |
| 50 | First buoyancy member       |
| 51 | Second buoyancy member      |
| 52 | Third buoyancy member       |
| 53 | Fourth buoyancy member      |
| 60 | Device for distributing gas |
| 62 | Gas supply                  |
| 64 | Inflated hose               |

## Patent claims:

1. An underwater rapid unloading system having a container (20) which can be carried on the outer side of a submarine (10) and a carrier frame (30) which is supported inside the container (20), characterized in that a disposable palette (40) is arranged on the carrier frame (30) and in that the disposable palette (40) can be connected to the carrier frame (30).
2. The underwater rapid unloading system as claimed in 1, characterized in that the carrier frame (30) can be completely deployed out of the container (20).
3. The underwater rapid unloading system as claimed in either of the preceding claims, characterized in that the disposable palette (40) can be connected to the carrier frame (30) via at least two locks.
4. The underwater rapid unloading system as claimed in one of the preceding claims, characterized in that the disposable palette (40) comprises a buoyancy system.
5. The underwater rapid unloading system as claimed in claim 4, characterized in that the buoyancy system comprises at least a first inflatable buoyancy member (50).
6. The underwater rapid unloading system as claimed in claim 5, characterized in that the buoyancy system comprises at least a second inflatable buoyancy member (51) and in that the buoyancy system comprises a device for distributing gas (60) from a gas supply (62) to the at least one first inflatable buoyancy member (50) and the at least one second inflatable buoyancy member (51).
7. The underwater rapid unloading system as claimed in claim 6, characterized in that the gas supply (62) comprises a compressed air connection, and wherein a diver can feed in compressed air from a breathing apparatus of the diver via the compressed air connection.

8. The underwater rapid unloading system as claimed in claim 6, characterized in that the gas supply (62) comprises a compressed air bottle, wherein the compressed air bottle is connected to the disposable palette (40).
9. The underwater rapid unloading system as claimed in one of claims 5 to 8, characterized in that the device for distributing gas (60) is constructed as an inflatable buoyancy member.
10. The underwater rapid unloading system as claimed in claim 9, characterized in that the device for distributing gas (60) completely surrounds the disposable palette (40).
11. The underwater rapid unloading system as claimed in claim 9 or claim 10, characterized in that the buoyancy system comprises a front region and a rear region, and wherein the buoyancy of the buoyancy system in the front region differs from the buoyancy of the buoyancy system in the rear region.
12. The underwater rapid unloading system as claimed in claim 11, characterized in that a control valve or a throughflow limiter is arranged between the front region and the rear region.
13. The underwater rapid unloading system as claimed in one of claims 5 to 12, characterized in that the buoyancy members are constructed in such a manner that the buoyancy members lift the disposable palette (40) in such a manner that the disposable palette (40) is lifted off from the carrier frame (30), wherein the carrier frame (30) is located completely inside the container (20).
14. A disposable palette (40) for an underwater rapid unloading system as claimed in one of the preceding claims.