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(54) **A SUB-SEA MATTRESS AND LIFTING DEVICE THEREFOR**

UNTERWASSERMATRATZE UND HEBEVORRICHTUNG DAFÜR

MATELAS SOUS-MARIN ET SON DISPOSITIF DE LEVAGE

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Description

Field of the Invention

[0001] The present invention relates to a sub-sea mattress and a method of lifting said sub-sea mattress from one location to another. In particular, the present invention provides a means of moving multiple sub-sea mattresses simultaneously without the use of an external intermediary supporting framework beneath the mattresses.

Background to the Invention

[0002] Sub-sea mattresses, usually formed of concrete, are utilised widely in the stabilisation and protection of structures such as sub-sea pipelines, umbilicals and cables. This stabilisation is achieved by adding global weight and hydrodynamic edge optimisation to resist wave and current actions. The mattresses are usually laid over the structure and so provide protection from wave action and falling debris such as dropped objects.

[0003] The mattresses typically comprise individual generally cuboidal or rectangular concrete blocks, held together in an array by a flexible means, for example a polypropylene rope. The shape and size of the blocks can be optimized for purpose; for example, edge profiling and increased block density can be used as a means of reducing the effect of drag in regions of strong sea currents.

[0004] The mattresses are produced in a factory remote from a dockside, and transported to said dockside. The mattresses are then lifted, by crane from the dockside and onto a ship for transportation to the use site. From the ship, they can then be off-loaded into the sea and properly installed.

[0005] Current means of lifting onto the ship utilise a metal framework on which one or more mattresses are stacked on top of each other. The framework and mattresses are then lifted together onto the ship. At the other end, the framework and mattresses can be lifted into the sea prior to final installation of the mattress. The problem then remains as to storage and movement of the framework. Once the load has been removed from the framework, the framework can swing more freely and so its potential to cause damage is increased. Moreover, a framework must be stored: either on deck or in onshore facilities. This requires space, which could be used for other purposes and so is an additional cost to a business. Moreover, frameworks are typically rented from a manufacturer, often the mattress producer, and so the longer the user retains the framework, the more costly it becomes. EP 2 921 754 A1 discloses such a loader for moving concrete mattresses between locations, the loader having a top frame and a lower support frame comprising webbing straps supporting the stack of concrete mattresses. Z

[0006] A known solution to the use of a metal frame-

work is to use a single rope or a plurality of ropes set into the concrete blocks. These ropes can be formed into loops and used to attach to the top crane, via straps, for use in moving the mattresses from one location to another. Such a system has however, several drawbacks which limit the maximum weight capacity and therefore, as a result, only one mattress can be moved at a time. With each mattress taking 5-10 minutes to load, the time taken to load the mattresses and the associated costs, quickly accumulate. Additionally, where mattresses need to be transported between locations by land, then weight is a critical factor in order for a transporter to meet the weight limitations of the highways used. The removal of the need to include a metal frame as part of the transported load increases the number of mattresses which can be carried as part of a single load. WO 01/88277 A1 discloses such a concrete mattress for use in underwater environments, the mattress comprising a plurality of blocks linked together by linkage means, said linkage means comprising one or more ropes cast within each block to retain the blocks within the mattress in a flexible relationship to each other, said plurality of blocks further comprising profiled edge blocks and central blocks, the blocks being linked in an array comprising rows and columns of blocks. Z

[0007] The present invention seeks to address the above problems and provide a mattress which can be lifted between locations without the need for a framework and moreover provide a system that can support the weight of multiple mattresses being moved simultaneously.

Summary of the Invention

[0008] According to a first aspect of the invention, there is provided a concrete mattress for use in underwater environments, the mattress comprising a plurality of blocks linked together by linkage means, said linkage means comprising one or more ropes cast within each block to retain the blocks within the mattress in a flexible relationship to each other, said plurality of blocks further comprising profiled edge blocks and central blocks, the blocks being linked in an array comprising rows and columns of blocks, wherein the composition and reaction conditions used in the production of said concrete mattress provide sufficient physical characteristics to support the forces associated with moving more than one mattress during loading and unloading without said rope pulling out of said concrete mattress, characterised in that from an edge block at the end of each row and column the rope is formed into a loop in which either or both ends are fixed into a single block, or each end of the loop is fixed into adjacent blocks.

[0009] Preferably, said plurality of blocks comprises blocks of different sizes, and further preferably, the smallest blocks are provided in alternate rows of blocks of a mattress.

[0010] Preferably, the blocks are linked in an array

comprising rows and columns of blocks. This allows for the blocks to be tailored to fit together in a desired arrangement more easily. Optionally, said edge blocks and said central blocks have distinct concrete densities and casting conditions to produce distinct physical characteristics to enable the mattress to be more easily lifted, with no requirement for a support frame beneath the mattress. Further optionally, the edge blocks are of higher density than the central blocks. Preferably, said rope is cast within said concrete mattress in rope is cast within said concrete mattress in curved conformation to minimise the risk of the rope being pulled out of the mattress or a block thereof.

[0011] Conveniently, said rope is between about 20 mm and about 50 mm in diameter.

[0012] Optionally, a rope is formed of polypropylene, or alternatively of woven steel wire.

[0013] According to a second aspect of the invention, there is provided a method of moving a plurality of concrete mattresses suitable for being transported to underwater environments without the use of external metal support structures beneath the mattresses, the method comprising the steps of: casting a plurality of concrete blocks linked together by one or more ropes, said plurality of blocks further comprising profiled edge blocks and central blocks, the blocks being linked in an array comprising rows and columns of blocks, the composition and casting conditions of said concrete mattress being sufficient to provide characteristics able to support the forces associated with moving more than one mattress during loading and unloading, wherein, from an edge block at the end of each row and column the rope is formed into a loop in which either or both ends are fixed into a single block, or each end of the loop is fixed into adjacent blocks, stacking mattresses atop one another, attaching loading straps from the top frame to the ropes of the bottom-most mattress, lifting the stack of mattresses using a reinforced top frame.

Brief Description of the Drawing

[0014] The invention is described with reference to the accompanying drawing which shows by way of for example only, one embodiment of a mattress. In the drawing:

Figure 1 is a perspective view of a stack of mattresses in accordance with the invention;

Figure 2 is a front elevation showing mattresses lifted by an installation frame; and

Figure 3 illustrates a stack of mattresses which are in accordance with the invention.

Detailed Description of the Invention

[0015] The invention as described herein enables the lifting and transportation of concrete mattresses without the need for steel support frameworks such as a conven-

tional frame (often referred to as a speedloader frame) on which the prior art mattress is supported during transport and which frame is directly attached to the lifting means so bearing weight of the mattresses. Moreover, the invention allows multiple concrete mattresses to be moved simultaneously without the use of conventional metal frames. The mattresses are also able to withstand forces experienced during lifting on and off ship, which forces can be quite large due to the continuous and impulse forces acting on the mattress during the movement (e.g. from the wind, waves, turning) which can give an effective mass to the mattress of up to 4 times its nominal mass.

[0016] This approach runs counter to that of the industry at the current time, as the expectation is that in order to move multiple mattresses simultaneously, the mattresses need to be supported by a rigid framework of some sort. This is believed to be required to ensure that the mattresses are not damaged and so rendered unsuitable for purpose and also to ensure a safe working environment. It is recognised within the industry, that casting rope into the concrete mattresses enables single mattresses to be moved without the use of a metal support framework. However, when lifting mattresses using ropes embedded in the blocks, the dominant force acts along the rope which is a direction in which the bond between the concrete and rope is at its weakest. Therefore there is a tendency for the ropes to pull out of the concrete mattress when under strain. Also the rope can break at the point the rope exits the mattress, the above reasons therefore creating the limitation that only single mattresses can be moved at a time.

[0017] In order to solve the above issues, and obviate the need for a support frame beneath the mattresses, which support frame usually bears the load rather than the mattresses, the material from which individual blocks which constitute mattresses, is required to be of a particular quality to ensure that the block does not break. Further the block material must be such that the rope does not slip through the block along its length. Both of these outcomes would be extremely dangerous to personnel and property within the area around where the lifting is taking place and render the mattress unusable. Therefore, the method of manufacture of the block is carefully controlled to produce concrete of the required physical characteristics.

[0018] In addition, the location of individual blocks within the mattress creates a variation in the size and type of forces it will endure during loading and therefore necessitates a variation in the physical properties of the block. For example, the blocks at the edges of the mattress are often profiled to resist the wave action when in situ on the sea-bed. Whilst in transit, however, these regions of reduced thickness will be under large tension forces from the integrated ropes, which act to exerting force perpendicularly away from the outer face block. As a result, the edge regions may require a denser concrete mix, capable of withstanding an increased force than

those blocks within the centre of the mattress. The blocks within the centre of the mattresses will be under lower compressive force but the pressure on the cast rope will create tensile strain. As a result, the concrete mix of those blocks within the centre of the mattress will be tailored to produce tensile strength rather than compressive or shear strength. The added benefit of this system is that the centre blocks can be of decreased density, reducing the cost to produce such blocks and decreasing the weight of the overall mattress.

[0019] Referring to Figure 1, this shows a stack of mattresses 10, partially suspended from a top frame (not shown). The top frame and the mattresses 10 are connected together by means of the straps 11. Each of the mattresses 10 is formed of a plurality of blocks 12 made of concrete. The blocks 12 are arranged to form a rectangular array of columns 13 and rows 14. It will be noted that smaller blocks 12b are incorporated into alternate rows in order to offset adjacent columnar blocks 12a along a row, to the block in a neighbouring column. The thickness of an individual block is chosen to suit the end-purpose, but is typically from 120 - 350 mm and especially from 150 - 300 mm.

[0020] In order to hold the array together, a block is linked to its neighbour in the or each adjacent column by means of a single rope or a plurality of ropes 15, typically formed of a plastics material such as polypropylene, and also typically of fibres, bound, woven or thermally bonded together. Additionally, each block 12 is linked, again by means of a single rope or a plurality of ropes 15 to the or each adjacent block 12 in a row. It should be understood that any reference to a rope, includes the embodiment of a mattress which utilises multiple ropes.

[0021] In the preferred embodiment shown in Figure 1, the rope 15 is cast in the concrete so that

[0022] from an edge block at the end of each row and column, in accordance with the invention, the rope is formed into a loop 16 in which either or both ends are fixed into a single block 12, or each end of the loop 16 is fixed into adjacent blocks 12. Preferably, a single rope 15 is run up and down the columns forming loops at alternating ends of the mattress, and the rope is curved to run down the adjacent column in the array. Once the rope has been run through every column in the array, it is rotated through 90 degrees horizontally, to repeat the formation along every row in the array, again alternating the formation of loops at the ends of the mattress.

[0023] The loops 16 formed at the ends of the mattress provide points of attachment, which can be linked to the top frame via hooks, straps, chains or any other suitable attachment means known in the art. In the embodiment of figure 1, straps 11 are passed through the loops 16 at opposite ends of either the rows, columns or both, and attached to the top frame (not shown). The top frame is of standard industry dimensions, approximately 6 m long and 2.5 m wide, however, it has been upregulated for the increased weight created by moving multiple mattress simultaneously and the dynamic amplification factor of

working through the wave zone. For example, the average sub-sea concrete mattress weighs around 10T. Including the relevant amplification factors, the average top frame has to be able to withstand 34 tf in order to lift and move such a mattress. As the disclosed system moves multiple mattresses simultaneously, the frame must be capable of withstanding in excess of about 3, 4 or 5 times this figure.

[0024] The ropes 15 are incorporated into the block 12 during the casting process and so are held into the block by intimate mixing with the concrete, which binds into the rope and particularly any fibres so forming a strong bond between the block and the rope. The rope 15 is set within the liquid concrete mix, in a pattern designed not only to connect the array of blocks together, but also to provide strength. Primarily, concrete is a material that excels in compression according to pure beam bending theory, making it ideally suited to protecting objects from falling debris or the like. However, during lifting, the concrete mattress is put under tension, having to withstand the tension in the rope acting to pull the rope out of the mattress. In order to resist this tension force, the concrete mix and the casting conditions are carefully regulated and monitored to produce the tensile strength required to resist slipping of the mattress on the rope.

[0025] As examples of methods of manufacture and compositions suitable for us in the present invention, the following may be cited.

Example 1

[0026] To 2.5 parts cementitious material (Cemento Tudela, from Sherburn), is added 3.5 parts of a first aggregate material having a particle distribution of 4 - 20mm (Scorton, from GWLee & Sons), 3.5 parts of a second aggregate material having a particle distribution of 4 - 10mm (Scorton, from GWLee & Sons), and 5.5 parts of a third aggregate material having a particle distribution of <4mm (Hull, from Shire Aggregates), along with 1 part water. Additionally, 1/80 parts of plasticiser (CHRYSO (RTM) RMD, from CHRYSO UK) is added. This gives a pre-concrete product having a free water to cementitious material of 0.4, a fines content of 40% and a slump of, typically, 75mm. The components were thoroughly mixed and allowed to set.

Example 2

[0027] To 2.1 parts cementitious material (Cemi (OPC), from Cemex), is added 3.6 parts of a first aggregate material having a particle distribution of 10 - 20mm (10/20mm concrete aggregate from Laird Aggregate), 1.5 parts of a second aggregate material having a particle distribution of 4 - 10mm (4/10mm Concrete aggregate from Laird Aggregate), and 4.5 parts of a washed sand having a particle distribution of <4mm (washed concrete sand from Laird Aggregate), along with 1 part water. Additionally, 1/50 parts of modified polycarboxylate plasti-

ciser (Viscocrete 35RM, from Sika Limited) is added. This gives a pre-concrete product having a free water to cementitious material of 0.47 and a slump of, typically, S3. The components were thoroughly mixed and allowed to set.

Example 3

[0028] To 2.2 parts cementitious material (Cemi (OPC), from Cemex), is added 3.6 parts of a first aggregate material having a particle distribution of 10 - 20mm (10/20mm concrete aggregate from Laird Aggregate), 1.5 parts of a second aggregate material having a particle distribution of 4 - 10mm (4/10mm Concrete aggregate from Laird Aggregate), and 4.3 parts of a washed sand having a particle distribution of <4mm (washed concrete sand from Laird Aggregate), along with 1 part water. Additionally, 1/50 parts of modified polycarboxylate plasticiser (Viscocrete 35RM, from Sika Limited) is added. This gives a pre-concrete product having a free water to cementitious material of 0.47 and a slump of, typically, S3. The components were thoroughly mixed and allowed to set.

[0029] In an embodiment, the rope 15 is set within the mattress so that there is a small flexure within each block, and the rope is therefore slack, being in the form of a curve within the block. When put under tension, such as during loading, the rope will attempt to straighten from the curved conformation, dissipating the force to the surrounding concrete and reducing the possibility of the rope being pulled from the mattress.

[0030] In an embodiment, the rope 15 is formed of steel wire, particularly stainless-steel wire. Steel wire ropes have the advantage that they do not degrade due to ultra-violet radiation exposure when used in shallow waters. In addition, stainless steel wire ropes are resistant to rusting and oxidation when in-situ under water. In a further embodiment, the rope can be formed of a plastics material into which are woven steel wire strands to increase the strength of the rope.

[0031] The rope 15 is between 20-50mm in diameter, depending on the material used and the requirement of the individual task. It will be understood by those skilled in the art, that mattresses of higher density, and therefore overall weight, would preferably utilise the use of ropes with increased strength. This is optionally achieved via use of a rope of increased rope diameter or via the use of steel wire ropes which have greater tensile strength. However, it should also be understood that at certain concrete densities, the mass of the block and/or mattress is such that a steel rope of 20 mm, has the capacity to cut into the profiled edge of a concrete block, damaging the block and making the block unusable. It can therefore be understood how the characteristics of the concrete blocks and the rope must be carefully balanced to optimise performance in the specific conditions of the site. In addition, ropes 15 having a greater diameter have a greater bend radius, and may necessitate the use of an

alternative rope formation in order to avoid kinking and therefore damage to the rope.

[0032] The blocks 12a and 12b, are not held rigidly in place and therefore the mattress retains a degree of flexibility which enables the mattress to follow the contours of the structure being protected.

[0033] In an embodiment, the rope 15 is cast in the concrete so that at the end of each row and column the rope is formed into a loop 16 such that either: 1) both ends are fixed into a single block 12, or 2) each end of the loop 16 is fixed into adjacent blocks 12. The loops 16 are used to aid the lifting process in that the straps 11 are passed therethrough. Alternatively, the straps 11 can be attached to the loops 16 via a hook attachment or any other suitable means. On lifting therefore, the chances of the straps 11 slipping and a lifting of the centre of mass of the mattresses is reduced.

[0034] Figure 2 illustrates in more detail, lifting of a stack of mattresses in accordance with the current invention. Here a stack of mattresses 20, 21 is shown. The bottom-most mattress 20 is in accordance with the current invention, and has general dimensions. The other four mattresses are in accordance with the prior art and each having overall dimensions 6m by 3m by 150mm.

[0035] The mattresses are supported by a lifting frame 30 having two tubular beams 22 in spaced parallel arrangement, and connected by cross-beams 23, at least some of which are orientated perpendicularly to the tubular beams 22. The lifting frame 30 is connected to the mattress stack by means of flat webbing slings 24, each rated to 3 tonnes. The length of a sling is typically around 3m, but can be chosen to suit the use and location. A wear-sleeve can be included about a sling is typically around 3m, but can be chosen to suit the use and location. A wear-sleeve 25 can be included about the outside of a sling 24 to increase its usable life. Each sling 24 is connected at a first end to the lifting frame 30 to a shackle 26 using a quick release mechanism. The quick release mechanism is actuated, in the illustrated embodiment using the handle 27.

[0036] The second end of the sling 24 supports a green-pin shackle 28, which is attached to and supports a 7mm yoke-eye type hook 28a. The hook engages a loop 16 extending from a mattress 20 in accordance with the invention. The rope material from which the loop 16 is made is a high tenacity rope or polysteel rope.

[0037] Pad-eyes 29 attached to the tubular beams 22 are utilised to attach the lifting frame 30 to a crane hook bearing point 31, by which the frame and mattress assembly can be lifted. Typically, the overall height from the bearing point 31 to the base of the bottom-most mattress 20 of the illustrated frame and mattress assembly, when extended during lifting is around 7.3m.

[0038] In use, the mattresses 40 are stacked one atop another, as shown in Figure 3, to the desired level and weight, at the site of manufacture, ready for loading and transport. The top frame is manoeuvred into place above the mattress stack and suitable attachments means are

connected to the loops 16 of the bottom most mattress. In the example of figure 1, loading straps 11 are fed through the loops 16 at the end of each column of the bottommost mattress. Due to the improved characteristics of the concrete mix and the rope arrangement, the mattress can support the increased weight of the additional mattresses without risk of damaging the mattresses or endangering nearby people or property.

[0039] In an especially preferred embodiment, the bottom-most mattress has increased strength over conventional mattresses, due to its construction in line with the above-described invention and also in respect of being able to support a load resting thereon. Particular loads contemplated are other mattresses also in accordance with the invention, but also, preferably, mattresses which are of a type known in the art, typically used in protecting sub-sea structures. In such a configuration and method therefore, the bottom-most mattress is used in the stead of a conventional metal frame to aid in relocation of standard mattresses, but which, unlike a metal frame can be utilised in the protection of said sub-sea structures, similarly to a normal mattress.

[0040] Usually the top frame used during lifting is rated to carry a load of multiples of the combined weight of the mattresses in the stack. This reduces to an acceptable risk level the risk of the frame distorting during lifting.

Claims

1. A concrete mattress (10) for use in underwater environments, the mattress comprising a plurality of blocks (12) linked together by linkage means (15), said linkage means comprising one or more ropes cast within each block to retain the blocks within the mattress in a flexible relationship to each other, said plurality of blocks further comprising profiled edge blocks and central blocks, the blocks being linked in an array comprising rows and columns of blocks, wherein the composition and reaction conditions used in the production of said concrete mattress provide sufficient physical characteristics to support the forces associated with moving more than one mattress during loading and unloading without said rope pulling out of said concrete mattress, **characterised in that** from an edge block at the end of each row and column the rope is formed into a loop (16) in which either or both ends are fixed into a single block (12), or each end of the loop (16) is fixed into adjacent blocks (12).
2. A concrete mattress according to claim 1, wherein said plurality of blocks comprises blocks of different sizes.
3. A concrete mattress according to either of the claim 2, wherein the smallest blocks are provided in alternate rows of blocks of a mattress.
4. A concrete mattress according to any preceding claim, wherein said edge blocks and said central blocks have different concrete densities and casting conditions to produce distinct physical characteristics.
5. A concrete mattress according to claim 4, wherein the edge blocks are of higher density than the central blocks.
6. A concrete mattress according to any of the preceding claims, wherein said rope is cast within said concrete mattress in curved conformation.
7. A concrete mattress according to any of the preceding claims, wherein said rope is between about 20 mm and about 50 mm in diameter.
8. A concrete mattress according to claim 7, wherein said rope is formed of polypropylene.
9. A concrete mattress according to claim 7, wherein said rope is formed of woven steel wire.
10. A method of moving a plurality of concrete mattresses suitable for being transported to underwater environments without the use of external metal support structures beneath the mattresses, the method comprising the steps of: casting a plurality of concrete blocks linked together by one or more ropes, said plurality of blocks further comprising profiled edge blocks and central blocks, the blocks being linked in an array comprising rows and columns of blocks, the composition and casting conditions of said concrete mattress being sufficient to provide characteristics able to support the forces associated with moving more than one mattress during loading and unloading, wherein, from an edge block at the end of each row and column the rope is formed into a loop (16) in which either or both ends are fixed into a single block (12), or each end of the loop (16) is fixed into adjacent blocks (12), stacking mattresses atop one another, attaching loading straps from the top frame to the ropes of the bottom-most mattress, lifting the stack of mattresses using a reinforced top frame.
11. A method according to claim 10, wherein both ends of a loop are cast in the same edge block.
12. A method according to claim 10 or claim 11, wherein said plurality of blocks comprises blocks of different sizes.
13. A method according to claims 10 - 12, wherein the smallest blocks are provided in alternate rows of blocks of a mattress.
14. A method according to claims 10 - 13, wherein said

edge blocks and said central blocks have different concrete densities and casting conditions to produce distinct physical characteristics.

Patentansprüche

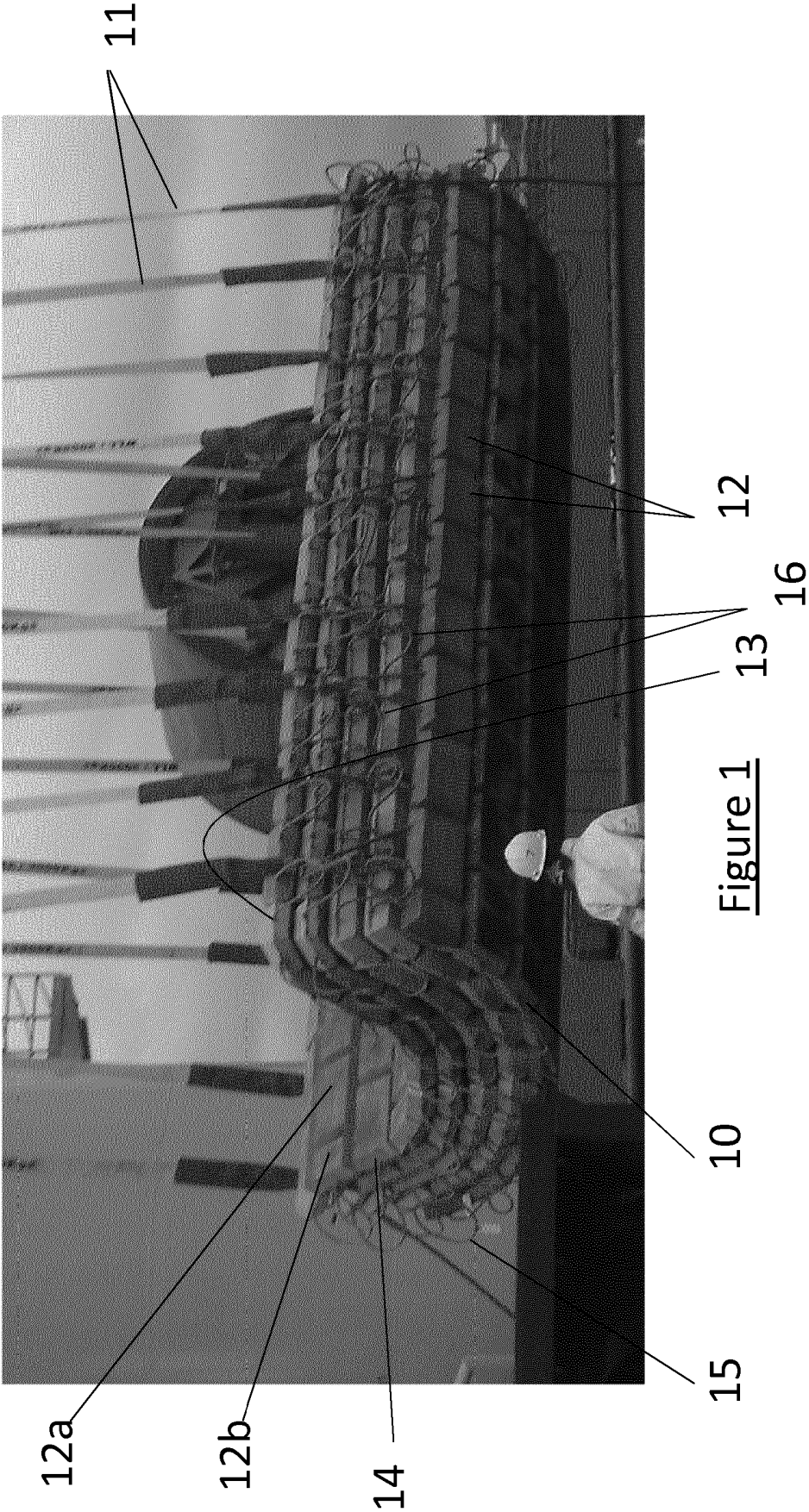
1. Betonmatratze (10) zur Verwendung in Unterwasserumgebungen, wobei die Matratze eine Vielzahl von Blöcken (12) umfasst, die durch Verbindungsmittel (15) miteinander verbunden sind, wobei die Verbindungsmittel ein oder mehrere Seile umfassen, die in jeden Block eingegossen sind, um die Blöcke innerhalb der Matratze in einer flexiblen Beziehung zueinander zu halten, wobei die Vielzahl von Blöcken ferner profilierte Randblöcke und zentrale Blöcke umfasst, wobei die Blöcke in einer Anordnung verbunden sind, die Reihen und Spalten von Blöcken umfasst, wobei die Zusammensetzung und die Reaktionsbedingungen, die bei der Herstellung der Betonmatratze verwendet werden, ausreichende physikalische Eigenschaften bereitstellen, um die Kräfte zu unterstützen, die mit dem Bewegen von mehr als einer Matratze während des Be- und Entladens verbunden sind, ohne dass das Seil aus der Betonmatratze herausgezogen wird, **dadurch gekennzeichnet, dass** das Seil von einem Randblock am Ende jeder Reihe und Spalte zu einer Schleife (16) geformt wird, in der entweder eines oder beide Enden in einem einzelnen Block (12) befestigt sind, oder jedes Ende der Schleife (16) in benachbarten Blöcken (12) befestigt ist.
2. Betonmatratze nach Anspruch 1, wobei die Vielzahl von Blöcken Blöcke unterschiedlicher Größe umfasst.
3. Betonmatratze nach einem des Anspruchs 2, wobei die kleinsten Blöcke in abwechselnden Blockreihen einer Matratze angeordnet sind.
4. Betonmatratze nach einem der vorhergehenden Ansprüche, wobei die Randblöcke und die mittleren Blöcke unterschiedliche Betondichten und Gießbedingungen aufweisen, um unterschiedliche physikalische Eigenschaften zu erzeugen.
5. Betonmatratze nach Anspruch 4, wobei die Randblöcke eine höhere Dichte aufweisen als die mittleren Blöcke.
6. Betonmatratze nach einem der vorhergehenden Ansprüche, wobei das Seil in der Betonmatratze in gekrümmter Form gegossen ist.
7. Betonmatratze nach einem der vorhergehenden Ansprüche, wobei das Seil einen Durchmesser zwischen etwa 20 mm und etwa 50 mm hat.

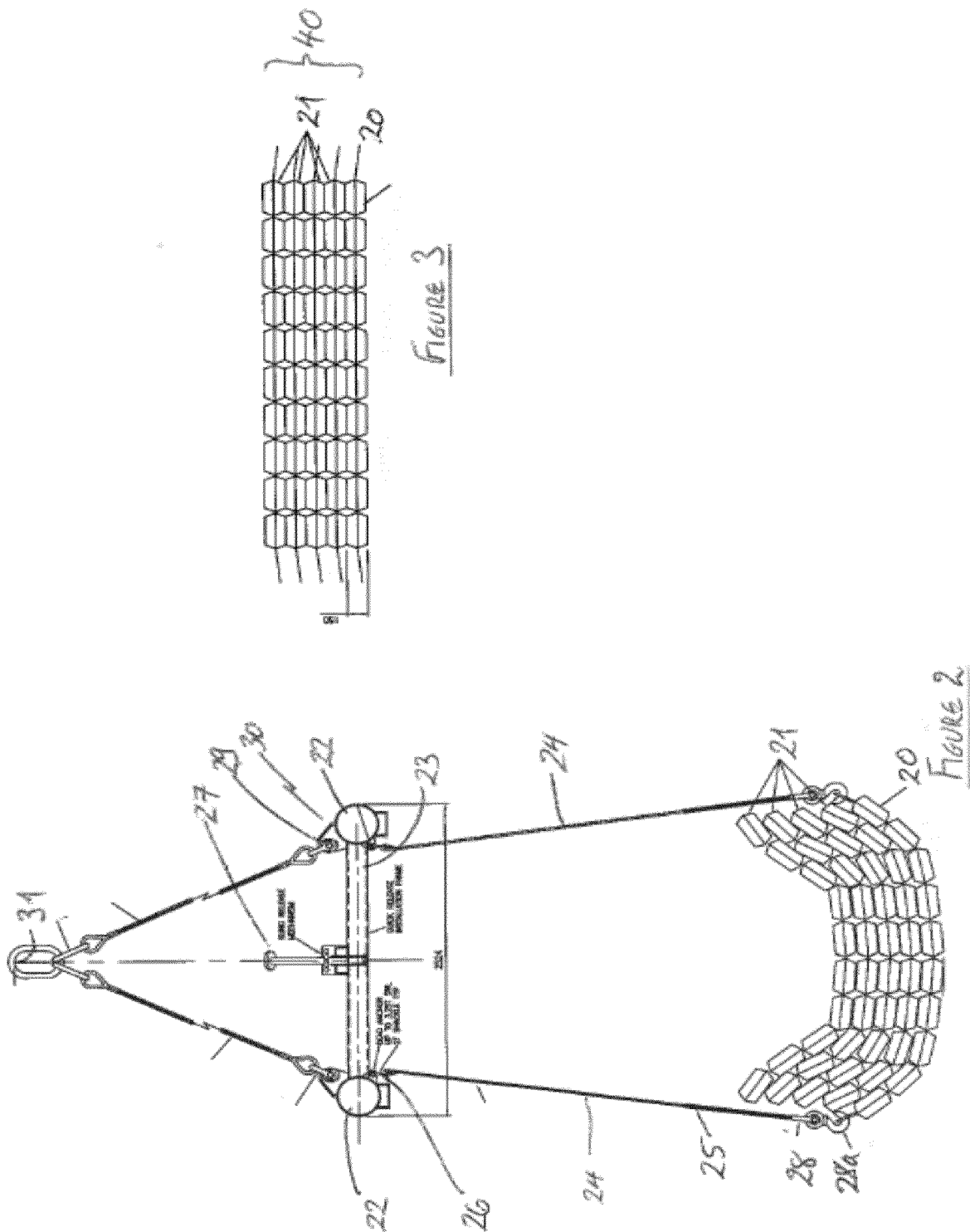
8. Betonmatratze nach Anspruch 7, wobei das Seil aus Polypropylen gebildet ist.
9. Betonmatratze nach Anspruch 7, wobei das Seil aus gewebtem Stahldraht gebildet ist.
10. Verfahren zum Bewegen einer Vielzahl von Betonmatratzen, die für den Transport in Unterwasserumgebungen geeignet sind, ohne die Verwendung von externen Metallstützstrukturen unter den Matratzen, wobei das Verfahren die folgenden Schritte umfasst: Gießen einer Vielzahl von Betonblöcken, die durch ein oder mehrere Seile miteinander verbunden sind, wobei die Vielzahl von Blöcken ferner profilierte Randblöcke und zentrale Blöcke umfasst, wobei die Blöcke in einer Anordnung verbunden sind, die Reihen und Spalten von Blöcken umfasst, wobei die Zusammensetzung und Gießbedingungen der Betonmatratze ausreichend sind, um Eigenschaften bereitzustellen, die in der Lage sind, die Kräfte zu unterstützen, die mit dem Bewegen von mehr als einer Matratze während des Be- und Entladens verbunden sind, wobei das Seil von einem Randblock am Ende jeder Reihe und Spalte aus zu einer Schleife (16) geformt wird, in der entweder ein oder beide Enden in einem einzigen Block (12) befestigt werden, oder jedes Ende der Schleife (16) in benachbarten Blöcken (12) befestigt wird, Stapeln der Matratzen übereinander, Befestigen von Ladebändern vom oberen Rahmen an den Seilen der untersten Matratze, Anheben des Matratzenstapels unter Verwendung eines verstärkten oberen Rahmens.
11. Verfahren nach Anspruch 10, wobei beide Enden einer Schleife in denselben Randblock gegossen werden.
12. Verfahren nach Anspruch 10 oder Anspruch 11, wobei die Vielzahl von Blöcken Blöcke unterschiedlicher Größe umfasst.
13. Verfahren nach einem der Ansprüche 10 bis 12, wobei die kleinsten Blöcke in abwechselnden Reihen von Blöcken einer Matratze angeordnet sind.
14. Verfahren nach einem der Ansprüche 10 bis 13, wobei die Randblöcke und die mittleren Blöcke unterschiedliche Betondichten und Gießbedingungen aufweisen, um unterschiedliche physikalische Eigenschaften zu erzeugen.

Revendications

1. Matelas en béton (10) destiné à être utilisé dans des environnements subaquatiques, le matelas comprenant une pluralité de blocs (12) reliés les uns aux autres par des moyens de liaison (15), lesdits

- moyens de liaison comprenant une ou plusieurs cordes coulées à l'intérieur de chaque bloc pour retenir les blocs à l'intérieur du matelas dans une relation flexible les uns par rapport aux autres, ladite pluralité de blocs comprenant en outre des blocs à bords profilés et des blocs centraux, les blocs étant reliés dans un réseau comprenant des rangées et des colonnes de blocs, dans lequel la composition et les conditions de réaction utilisées dans la production dudit matelas en béton fournissent des caractéristiques physiques suffisantes pour supporter les forces associées au déplacement de plus d'un matelas pendant le chargement et le déchargement sans que ladite corde ne se retire dudit matelas en béton, **caractérisé en ce que**, à partir d'un bloc de bord à l'extrémité de chaque rangée et colonne, la corde est formée en une boucle (16) dans laquelle l'une ou les deux extrémités sont fixées dans un seul bloc (12), ou chaque extrémité de la boucle (16) est fixée dans des blocs adjacents (12).
2. Matelas en béton selon la revendication 1, dans lequel ladite pluralité de blocs comprend des blocs de tailles différentes.
 3. Matelas en béton selon l'une ou l'autre de la revendication 2, dans lequel les blocs les plus petits sont prévus dans des rangées alternées de blocs d'un matelas.
 4. Matelas en béton selon l'une quelconque des revendications précédentes, dans lequel lesdits blocs de bord et lesdits blocs centraux ont des densités de béton et des conditions de coulage différentes pour produire des caractéristiques physiques distinctes.
 5. Matelas en béton selon la revendication 4, dans lequel les blocs de bord sont de densité plus élevée que les blocs centraux.
 6. Matelas en béton selon l'une quelconque des revendications précédentes, dans lequel ladite corde est coulée dans ledit matelas en béton selon une conformation incurvée.
 7. Matelas en béton selon l'une quelconque des revendications précédentes, dans lequel ladite corde a un diamètre compris entre environ 20 mm et environ 50 mm.
 8. Matelas en béton selon la revendication 7, dans lequel ladite corde est formée de polypropylène.
 9. Matelas en béton selon la revendication 7, dans lequel ladite corde est formée de fils d'acier tissés.
 10. Procédé de déplacement d'une pluralité de matelas en béton adaptés pour être transportés dans des environnements subaquatiques sans l'utilisation de structures de support métalliques externes sous les matelas, le procédé comprenant les étapes suivantes : couler une pluralité de blocs de béton reliés entre eux par une ou plusieurs cordes, ladite pluralité de blocs comprenant en outre des blocs de bord profilés et des blocs centraux, les blocs étant reliés en un réseau comprenant des rangées et des colonnes de blocs, la composition et les conditions de coulage dudit matelas en béton étant suffisantes pour fournir des caractéristiques capables de supporter les forces associées au déplacement de plus d'un matelas pendant le chargement et le déchargement, dans lequel, à partir d'un bloc de bord à l'extrémité de chaque rangée et colonne, la corde est formée en une boucle (16) dans laquelle l'une ou les deux extrémités sont fixées dans un bloc unique (12), ou chaque extrémité de la boucle (16) est fixée dans des blocs adjacents (12), empiler les matelas les uns sur les autres, attacher les sangles de chargement du cadre supérieur aux cordes du matelas le plus bas, soulever la pile de matelas en utilisant un cadre supérieur renforcé.
 11. Procédé selon la revendication 10, dans lequel les deux extrémités d'une boucle sont coulées dans le même bloc de bord.
 12. Procédé selon la revendication 10 ou la revendication 11, dans lequel ladite pluralité de blocs comprend des blocs de tailles différentes.
 13. Procédé selon les revendications 10 à 12, dans lequel les blocs les plus petits sont prévus dans des rangées alternées de blocs d'un matelas.
 14. Procédé selon les revendications 10 à 13, dans lequel lesdits blocs de bord et lesdits blocs centraux ont des densités de béton et des conditions de coulage différentes pour produire des caractéristiques physiques distinctes.





REFERENCES CITED IN THE DESCRIPTION

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