(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 746 213 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
**25.06.2014 Bulletin 2014/26**

(51) Int Cl.:
***B66C 23/53*** *(2006.01)* ***B63B 1/14*** *(2006.01)*

(21) Application number: **12460093.3**

(22) Date of filing: **21.12.2012**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**

(71) Applicant: **GTI Tymon Galewski**
**80-034 Gdansk (PL)**

(72) Inventor: **Galwski, Tymon**
**80-034 Gdansk (PL)**

(74) Representative: **Czabajski, Jacek**
**TRASET**
**Rzecznicy Patentowi Sp.p**
**Ul. Piecewska 27**
**80-288 Gdansk (PL)**

(54) **Floating crane**

(57) A floating crane comprises a bearing hull composed of interconnected parts, wherein on the hull a lifting device is installed. The parts (1,2) of the bearing hull in the form of a fixed part (1) and a movable part (2) are interconnected, one behind another, by means of at least one connector (3). The connector (3) is fixed on one side to the fixed part (1) of the bearing hull and on the other side it is movably fixed to the movable part (2) of the bearing hull, wherein the lifting device is mounted in the area of the centre of buoyancy (C) of the movable part (2) of the bearing hull in an operating position of the movable part (2). In a shipping position, the two parts (1, 2) of the hull are arranged in a top view in a line, one behind another. However, in an operating position, the movable part (2) of the hull is transversely arranged in relation to the fixed part (1) of the bearing hull, forming in a top view the shape of the letter T.

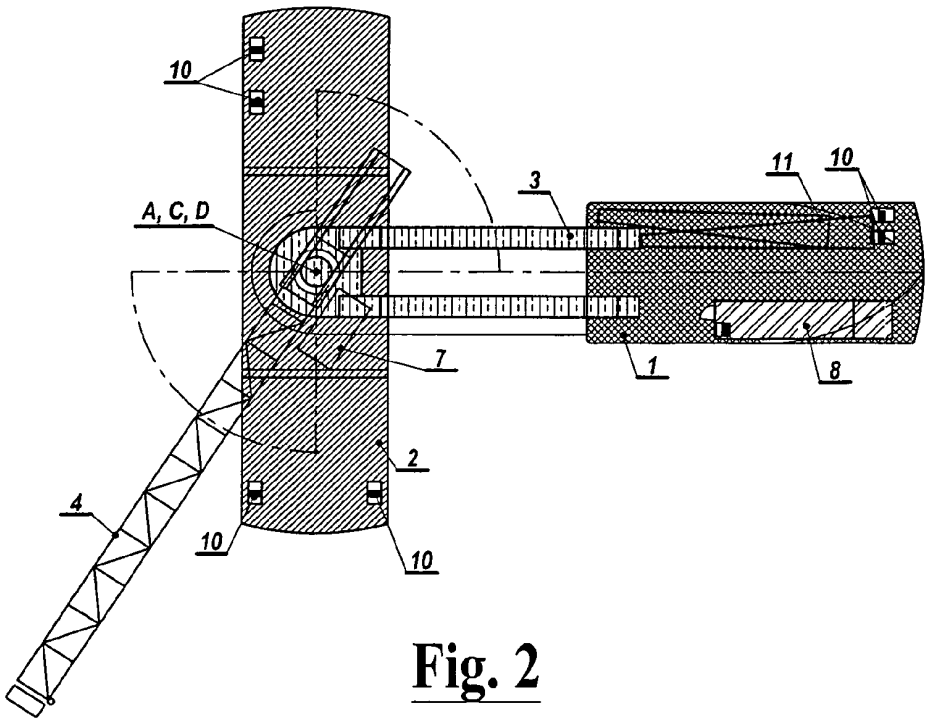


Fig. 2

EP 2 746 213 A1

## Description

**[0001]** The object of the invention is a floating crane comprising a vessel used in construction and hydraulic engineering works conducted from water, such as crane work in the construction of bridges, as well as dredging works with the movement of masses of soil from the bottom of dredged canals or banks. The crane is equipped particularly with lifting devices. When equipped, among others, with conveyor belts for the transportation of dredged material, the vessel may be a specialist excavator or a suction dredger. The floating crane is used on waterways of limited width, such as rivers, canals and locks.

**[0002]** Work carried out from water with the use of large overhang work equipment, such as cranes or conveyor belts, involve a significant load of vessels used for this purpose, where the load is usually beyond the outline of the hull of the vessel. The main problem in these cases is stability, and the lack of stability can result in the overturning of the vessel. The stability of the vessel for the described uses particularly depends on its width.

**[0003]** There are a number of solutions of vessels used as derrick barges or floating cranes. There are solutions of floating cranes with a fixed arm and floating cranes with a rotating arm. In each of these prior art solutions particularly important are solutions in the area of a vessel's stability during crane operations. In the solution known from the patent specification of international application No. WO 2007/091042, a method and system of installation of the structure at sea is described. The solution uses a floating crane. A method and system for transporting offshore structures such as a wind turbine generator includes supporting frames and a generator assembled on land. The frame in the vessel is used for lifting the structure of a complete generator, retaining it in the upright configuration and transferring to a pre-prepared foundation. A bearing element is the frame on the vessel. The supporting structure of the wind generator contains feet which are arranged on the foundation.

**[0004]** In another solution known from international patent specification No. WO 2008/142578, a crane support apparatus and methods thereof are presented. According to this known solution a vessel is provided with a device improving stability of jack-up rigs and derrick barges. The vessel has at least three independent engines. The vessel is also equipped with a lifting system and an empty hold where a crane may be mounted. The crane support is preferably affixed to tracks on which the crane can slide along the deck of the vessel. The raised and hollowed support structure of the crane enables the use of the space occupied by the crane for the storage of goods without hindering the movement of the crane structure along the tracks. The crane may be used for the expansion and assembly of offshore oil and gas platforms and underwater drillings.

**[0005]** Another known solution of a marine lifting device is presented in the patent specification of international application No. WO 2010/111061. This known solution presents a lifting device comprising a hull consisting of two parts connected in a catamaran system, designed to lift marine objects in a marine environment. The device comprises the first and the second hull that are spaced apart during crane operations. The first frame spans between the hulls. Also the second frame spans between both hulls. Both frames are spaced apart and connect both hulls of the vessel. The first frame is connected to the first hull with a universal joint and to the second hull with a hinged connection. The second frame is connected to the second hull with a universal joint and to the first hull with a hinged connection. Each frame extends upwardly in an inverted U-shape that provides space under each frame and in between the hulls for enabling a marine vessel to be positioned in between the hulls and under the frames.

**[0006]** Another known solution of a crane and a method of operation therefore is presented in US patent specification No. US 4,569,453. According to this known solution a crane structure is mounted on a marine vessel. The crane includes a gantry structure mounted on a vertical tower structure and includes boom portions protruding from the tower structure. Preferably, the boom portions may be pivotally lowered from their operating positions and then the tower structure may be rotated in a horizontal plane, thereby reducing the overall dimensions of the crane structure to facilitate transportation and avoid lower obstructions and narrow passageways.

**[0007]** Another *known solution of a floating crane is* presented in patent specification No. PL 120236. According to this known solution, on a hull of a floating crane a rotating part of the crane is situated, holding a boom and drives of its rotation and changes in its radius and lifting the load controlled by controllers, and containing a device for the compensation of a heel controlled according to a signal of a heel sensor. The crane contains a system of control of boom rotation drives, change in the boom radius and lifting the load on the basis of a signal of a heel sensor. This system of control includes a device processing the value of a heel angle into an electric signal transmitted to a heel adjustment hydraulic system.

**[0008]** The invention relates to a floating crane with a rotating lifting device. In this type of vessels there is a problem of the transverse stabilisation of a vessel.

**[0009]** The problem of the heel of a hull particularly occurs in the case of floating cranes with a rotating arm described above, including those operating on inland waters. The permissible width of vessels on a particular inland body of water is usually limited by the width of the narrowest lock in the area of the body of water. The permissible draught of these vessels is also limited by the depth of waterways in the area of the body of water, and that draught is limited by the shallowest area of the body of water on which the vessel operates. In a number of cases there are bodies of water where the width of the narrowest lock is 10 metres and the smallest permissible draught does not exceed 2 metres. Therefore, vessels

of these dimensions must in these areas fulfil the functions described above, especially this relates to the functions of a floating crane. The problem is the stability of these vessels, particularly when a crane operates with its arm leaned over a side board, so in most cases. At the same time, the limitation of the width of a vessel hinders the installation of complex devices correcting a heel during crane operations in a plane non-parallel to the longitudinal plane of symmetry of a vessel. The aim of the invention is to avoid this disadvantage.

**[0010]** A floating crane, according to the invention, is described in claim 1 and in the following dependent claims. The crane comprises a floating bearing hull composed of interconnected parts. On the bearing hull a lifting device is installed.

**[0011]** According to the invention, parts of the bearing hull in the form of at least one fixed part and at least one movable part are connected to one another by means of at least one connector. The connector is from one side fixed to the fixed part of the bearing hull and from the other side it is movably fixed to the movable part of the bearing hull. The term movably used here should be understood that the movable part of the hull can rotate on the water in a horizontal plane, where the pivoting point of the movable part is in a free end of the connector fixed to the fixed part of the bearing hull. The lifting device is installed in the area of the centre of buoyancy of the movable part of the bearing hull, in an operating position for crane work of this movable part of the bearing hull.

**[0012]** In an operating position the fixed part and the movable part of the bearing hull are preferably arranged in a top view in the shape of the letter T. This is achieved by rotation in a horizontal plane of the movable part in relation to the fixed part of the hull, preferably at a right angle.

**[0013]** The lifting device may comprise a working arm of the crane along with the mechanism of its rotation around a vertical axis of rotation, and a counterweight, a lifting mechanism and other known components of such a device.

**[0014]** The movable part of the hull in a preferred embodiment of the invention is at the back, behind the fixed part of the hull as seen in the direction of shipping. In this embodiment, the movable part of the hull is hauled behind the fixed part of the hull.

**[0015]** In another embodiment of the hull of the crane according to the invention, the movable part of the hull is before the fixed part of the hull as seen in the direction of shipping, and in this embodiment of the invention the movable part of the hull is pushed by the fixed part of the hull.

**[0016]** According to the invention, it is provided that the fixed part of the hull can contain at least one ballast tank for water with a hydraulic system for filling and emptying the tank. The movable part of the hull may also contain ballast tanks with a hydraulic system for their filling and emptying.

**[0017]** In a preferred embodiment of the invention, the fixed part of the bearing hull can be connected with the movable part of the hull by means of a two-arm connector. To working ends of both arms of the connector the movable part of the hull is rotationally fixed on a vertical axis of rotation. The working ends of both arms can be fixed by means of an outer ring of a central swing bearing of this movable part of the hull. An inner ring of the central bearing, of a vertical axis of rotation, is centrally mounted on the movable part of the hull. The term centrally should be understood that it determines the point on the movable part of the hull that corresponds in a top view to the area of the centre of buoyancy of this movable part.

**[0018]** The said two-arm connector may be U-shaped, where the above mentioned swing bearing of the movable part of the hull is arranged inside the curvature of the connector, in a seat between the two arms of the connector.

**[0019]** In a preferred embodiment of the invention, the said swing bearing of the movable part, fixed to the movable part of the hull can be a slide bearing.

**[0020]** The crane with a working arm with a vertical axis of rotation is mounted by means of the seat of the rotating working arm. The rotation seat of the crane is preferably centrally mounted in the movable part of the hull. The term centrally should be understood that the axis of rotation of the crane arm preferably corresponds to the area of the centre of buoyancy of the movable part of the bearing hull.

**[0021]** In a preferred embodiment of the invention, between the arms of the two-arm connector, along the longitudinal symmetry axis of both part of the hull, there is a bed of the arm of the lifting device in a shipping position. Generally, in a shipping position the working arm of the lifting device is expected to be lowered by rotation around its horizontal axis of rotation and arranged in the bed partly arranged on the movable part and partly on the fixed part of the hull, connected one behind another in a shipping position, when it is necessary to move the floating crane by water in another area of work.

**[0022]** According to the invention, it is provided that a deck house along with a social part of the floating crane can be located in the fixed part of the hull.

**[0023]** A wheelhouse *of the floating crane can comprise* at least one module raised on tilting arms.

**[0024]** In the solution according to the invention it is provided that in a shipping position, in a position of both parts of the hull in a line, one behind another, the length of the movable part of the hull from the axis of rotation of the movable part, along with the length of the fixed part () in a shipping position, is greater than the length of a rotating arm of the lifting device. This allows free positioning of the working arm of the lifting device in the bed in a shipping position.

**[0025]** According to the invention, it is also provided that in a shipping position all components of the lifting device in a top view are contained in the outline of the connected fixed part and movable part of the bearing hull.

**[0026]** In the solution according to the invention, a new

solution of a floating crane particularly for inland and coastal uses is developed. Previously known two-part hulls of floating cranes or derrick barges had a catamaran double-hull solution, which increased the stability of a vessel during crane works. However, when such a vessel moves on inland waters, the width of the hull is in many cases an obstacle for going through inland canals and locks during shipping to the place of work.

**[0027]** In the solution according to the invention, the hull consisting of the fixed part and the movable part connected in a line at the time of shipping one behind another and whose width is less than the width of the narrowest lock or navigable canal is not an obstacle for going through narrow locks and canals. However, in operating conditions, the movable part of the hull rotates in relation to the fixed part, in a horizontal plane around a vertical axis of rotation. In the solution according to the invention, the movable part of the hull is arranged in a place where crane work is carried out, for example by means of known side propellers, or other rotation mechanisms, perpendicularly to the fixed part of the hull. After blocking of the fixed part of the hull with the movable part of the hull in this configuration, similar to the shape of the letter T in a top view, a working arm of the lifting device from the fixed part is raised. The floating crane designed in such a way gets a significant increase in a lateral stability during crane work. At the same time, the fixed part of the hull connected by means of a connector with the movable part serves as a load ensuring the longitudinal stability of the crane during crane work. An additional element of the control of the crane stability is provided in the fixed part of the hull at least one ballast tank which can be filled and emptied depending on the needs. In a shipping position, the working arm of the lifting device is arranged in the bed partly on the movable part and partly on the fixed part of the hull, which additionally stiffens the system of both parts of the hull connected in a line, one behind another.

**[0028]** The object of the invention is presented in examples of realization in the accompanying drawings:

Fig. 1 - a floating crane in a top view in a shipping position.
Fig. 2 - a crane according to Fig. 1 in a crane work position.
Fig. 3 - a crane according to Fig. 1 in a side view.
Fig. 4 - a crane according to Fig. 2 in a side view.
Fig. 5 - a crane with two movable parts of the hull in a shipping position in a top view.
Fig. 6 - a crane according to Fig. 5 in a crane work position.

**[0029]** As shown in the embodiment in the accompanying Fig. 1, Fig. 2, Fig. 3 and Fig. 4, a floating crane comprises a floating bearing hull in the form of one fixed part 1 and one movable part 2. As shown in Fig. 1 and Fig. 3, in a configuration at the time of shipping, parts 1,2 are connected together, one behind another, in a line, by means of a connector 3. Both parts of the hull have a width not exceeding the width of the narrowest canal in the area of future shipping, for example a width not exceeding 10 metres. In the embodiment shown in Fig 1, Fig. 2, Fig. 3 and Fig. 4, the connector 3 is fixedly mounted on one side to the fixed part 1 of the bearing hull and on the other side it is movably mounted to the movable part 2 of the bearing hull. Thus, the movable part 2 of the hull can rotate on the water in a horizontal plane relative to the arm 3 fixedly mounted to the fixed part 1. The pivoting point of the movable part 2 of the hull is in a free end of the connector 3 fixedly mounted to the fixed part 1 of the bearing hull. As shown in figures from Fig. 1 up to Fig. 4, a lifting device 4 is installed on the movable part 2 of the bearing hull.

**[0030]** The lifting device 4 in this example of realization, comprises a crane along with a rotation mechanism of its working arm around a vertical axis of rotation D and a lifting mechanism and other known components of the crane not shown in the figure. Other examples do not exclude the use of other lifting devices, for example a temporarily mounted self-propelled lifting device instead of a crane.

**[0031]** The movable part 2 of the hull is at the back, behind the fixed part 1 of the hull as seen in the direction of shipping B. In this embodiment, the movable part 2 of the hull is hauled behind the fixed part 1 of the hull. This is shown in the drawings from Fig. 1 up to Fig. 4. However, other embodiments of the invention do not exclude that the movable part 2 of the hull is before the fixed part 1, and in this embodiment in a shipping position, the movable part 2 of the hull is pushed by the fixed part 1 of the hull.

**[0032]** In this embodiment, the fixed part 1 of the hull contains a ballast tank 12 for water, shown in Fig. 3 and Fig. 4, with a hydraulic system for filling and emptying the tank, which is not shown in the figure. The movable part 2 of the hull in other embodiments may also contain a ballast tank or ballast tanks with a hydraulic system for its filling and emptying.

**[0033]** The fixed part 1 of the bearing hull is connected in this embodiment with the movable part 2 of the hull be means of a two-arm connector 3. The said two-arm connector 3 in this embodiment is U-shaped, as shown in Fig. 1 and Fig. 2 and is made of segments that can be disconnected for any repairs and renovations. A swing bearing 5 of the movable part 2 of the hull enables rotation of this movable part 2 of the hull around a vertical axis of the bearing 5, in a horizontal plane. The bearing 5 is arranged in this embodiment inside the curvature of the connector 3, between both arms of the connector 3. This is shown in Fig. 1 and Fig. 2.

**[0034]** The central bearing 5 of a vertical axis of rotation, in the curvature between the arms of the connector 3 is fixed by means of an outer ring of the said bearing 5.

**[0035]** The bearing 5 has a vertical axis of rotation. An inner ring of the bearing 5 is centrally mounted on the movable part 2 of the hull. In this embodiment, as shown

in Fig. 1 and Fig. 2, the movable part 2 of the hull is equipped on the deck with a known central element on which a known inner ring of the bearing 5 is mounted. The term central determines the area on the deck of the movable part of the hull that corresponds in a top view to the area of the centre of buoyancy C of this movable part 2 of the hull. In this embodiment the said bearing 5 fixed to the movable part 2 of the hull is a slide bearing. Other embodiments do not exclude the use of other types of bearings.

**[0036]** The crane with a working arm, comprising in this embodiment a lifting device 4, with a vertical axis of rotation, is mounted by means of a known seat. The rotation seat of the working arm of the crane is centrally mounted in the movable part 2 of the hull. In this embodiment the axis of rotation D of the arm of the lifting device 4 in the form of a crane corresponds to the centre of buoyancy C of the movable part 2 of the bearing hull.

**[0037]** In this embodiment, between the arms of the two-arm connector 3, along the longitudinal axis of symmetry of both parts 1,2 of the hull, there is a bed of the working arm of the crane in a shipping position. In a shipping position, in this embodiment, the working arm of the crane is lowered by rotation around its horizontal axis of rotation fixing the working arm of the crane to the body of the crane. The working arm of the crane is at the time of shipping arranged in the bed partly located in the movable part 2 and partly in the fixed part 1 of the hull, connected one behind another, when the floating crane needs to be moved by water in another area of work. This embodiment also provides for a bed 11 of the extension of the arm of the lifting device on the fixed part 1 of the hull.

**[0038]** In this embodiment, as shown in Fig. 3 and Fig. 4, a wheelhouse 7 of the lifting device 4 along with a social part 13 of the floating crane are located in the fixed part 1 of the hull. The wheelhouse 7 of the floating crane comprises in this embodiment a module raised on tilting arms. This is clearly shown in Fig. 3 and Fig. 4.

**[0039]** In this embodiment, in a shipping position, both parts 1, 2 of the hull are arranged in a line, one behind another, as shown in Fig. 1 and Fig. 3. The length of the movable part 2 of the hull from the axis of rotation A of the movable part 2, along with the length of the fixed part 1, in a configuration at the time of shipping, is greater than the length of the working arm of the crane. This allows positioning the working arm of the crane in the bed in a shipping position partly on the movable part 2 and partly on the fixed part 1 of the bearing hull.

**[0040]** In this embodiment, in a shipping position, all components of the crane in a top view are contained in the outline of the interconnected fixed part 1 and the movable part 2 of the hull. This is shown in Fig. 1 and Fig. 2, where also the extension of the arm of the crane is arranged in the bed 11 on the fixed part 1 of the bearing hull.

**[0041]** Fig. 5 and Fig. 6 illustrate another embodiment of the floating crane according to the invention. In this embodiment, the hull of the crane consists of the fixed part 1 and two movable parts 2. In a shipping position the movable parts 2 are put into side seats in the fixed part 1 and are contained in an outer contour of the fixed part 1 of the hull. However, in the operating position of the lifting device, both movable parts 2 of the hull are moved aside by the rotation of fixing arms 3 and together with the arms 3 and the fixed part 1 of the hull, in the operating position take in an outer contour in a top view a shape similar to the letter T. The two movable parts 2 comprise in this embodiment a type of two side floats laterally stabilising the whole hull of the floating crane. The floats in an operating position, as a whole constitute the movable part 2 of the bearing hull. The area of the centre of buoyancy C of the moving part corresponds to the area of the centre of buoyancy in the embodiment shown in drawings from

**[0042]** Fig. 1 up to Fig. 4. This is shown in Fig. 6. When crane work is completed, the working arm of the crane is arranged on the bed along the fixed part 1 of the hull and then by turning the arms of the connector 3 both movable parts 2 are put into side seats in the fixed part 1 and the hull of the floating crane is in a configuration ready for shipping to another place of crane work. This is shown in Fig. 5.

**The list of designations in the drawings.**

**[0043]**

1. Fixed part of the hull.
2. Movable part of the hull.
3. Connector.
4. Lifting device.
5. Swing bearing of the movable part of the hull.
6. Swing bearing of the arm of the lifting device.
7. Wheelhouse of the lifting device.
8. Deck house of the fixed part.
9. Propellers of the fixed part.
10. Deck lifts of anchor and mooring lines.
11. Bed of the extension of the arm of the lifting device.
12. Ballast tank.
13. Social part.

A. Axis of rotation of the movable part.
B. Direction of shipping.
C. Centre of buoyancy of the movable part.
D. Axis of rotation of the arm of the lifting device.

**Claims**

**1.** A floating crane, comprising a bearing hull composed of interconnected parts, wherein on the hull a lifting device is mounted, **characterised in that** the parts (1,2) of the bearing hull in the form of at least one fixed part (1) and at least one movable part (2) are interconnected by means of at least one connector (3) fixed on one side to the fixed part (1) of the bearing

hull and on the other side movably fixed to the movable part (2) of the bearing hull, wherein the vertical axis of rotation (D) of the lifting device (4) is in the area of the centre of buoyancy (C) of the movable part (2) in an operating position of the movable part (2).

**2.** The floating crane, according to claim 1, **characterised in that** in an operating position the fixed part (1) and the movable part (2) of the bearing hull are arranged in a top view into the shape of the letter T.

**3.** The floating crane, according to claim 1 or 2, **characterised in that** the movable part (2) is arranged behind the fixed part (1) of the bearing hull.

**4.** The floating crane, according to claim 1 or 2, **characterised in that** the movable part (2) is arranged before the fixed part (1) of the bearing hull.

**5.** The floating crane, according to claim 1 or 2, **characterised in that** the fixed part (1) of the hull contains at least one ballast tank for water (12), together with a hydraulic system for filling and emptying the tank.

**6.** The floating crane, according to claim 1, **characterised in that** the connector (3) comprises a two-arm element, where working ends of the arms of the connector (3) are fixed to the movable part (2) of the hull by means of an outer ring of a swing bearing (5) of the moving part (2) relative to the fixed part (1) of the hull, wherein an inner ring of the swing bearing (5) of the movable part (2) is centrally mounted on the movable part (2) of the hull.

**7.** The floating crane, according to claim 6, **characterised in that** the two-arm connector (3) is U-shaped, where the swing bearing (5) of the movable part (2) of the hull relative to the fixed part (1) of the hull is arranged inside the curvature of the connector (3).

**8.** The floating crane, according to claim 6 or 7, **characterised in that** the swing bearing (5) of the movable part (2) of the hull relative to the fixed part (1) of the hull is a slide bearing.

**9.** The floating crane, according to claim 6 or 7, **characterised in that** a seat of the rotating working arm (4) of the crane is centrally mounted on the connector (3) in relation to the centre of buoyancy (C) of the movable part (2) of the hull.

**10.** The floating crane, according to claim 6 or 7, ***characterised in that*** between the arms of the two-arm connector (3), along the longitudinal axis of symmetry of the two parts (1, 2) of the hull there is a bed of the working arm (4) of the lifting device in a shipping position.

**11.** The floating crane, according to one of claims from 1 to 10, **characterised in that** a deck house (8) together with a social part (13) are located in the fixed part (1) of the hull.

**12.** The floating crane, according to one of claims from 1 to 11, **characterised in that** a wheelhouse (7) comprises at least one module raised on tilting arms.

**13.** The floating crane, according to claim 1, **characterised in that** in a shipping position the length of the movable part (2) of the hull from the axis of rotation (A) of the movable part (2), with the length of the fixed part (1), is greater than the length of the working arm of the lifting device (4).

**14.** The floating crane, according to one of claims from 1 to 13, **characterised in that** in a shipping position all components of the lifting device (4) in a top view are fixed in the outline of the interconnected fixed part (1) and movable part (2) of the bearing hull.

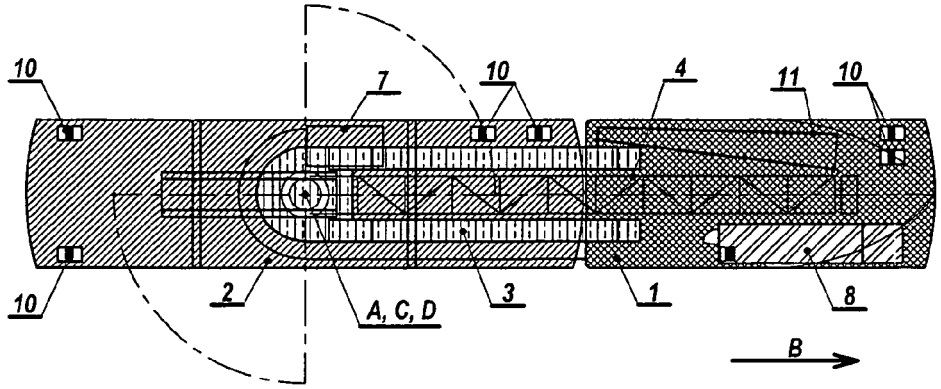


Fig. 1

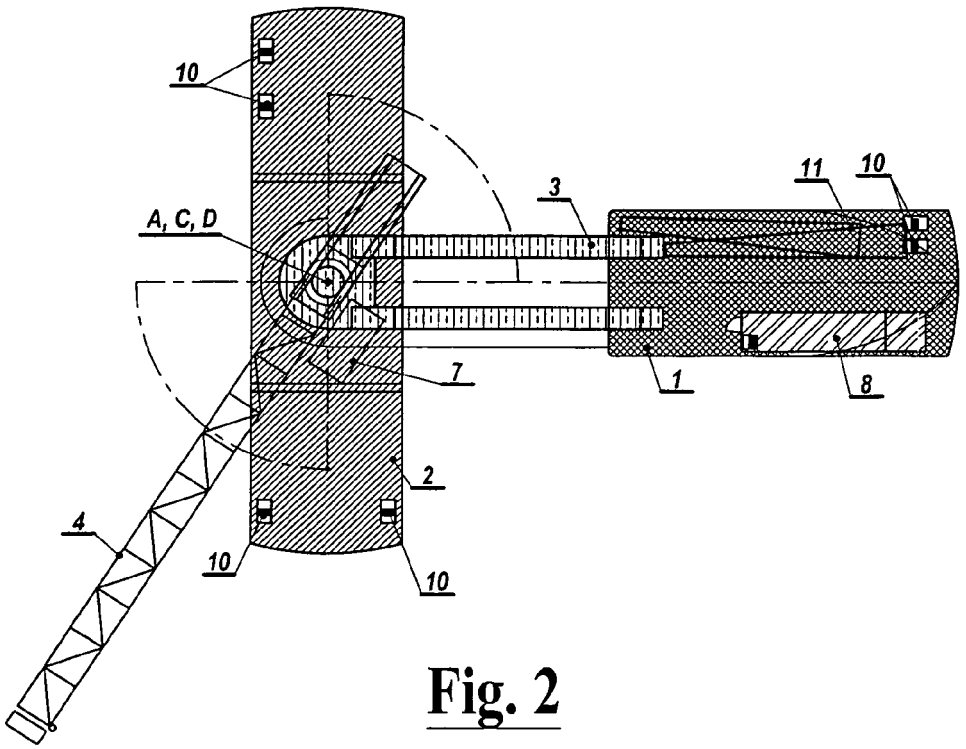


Fig. 2

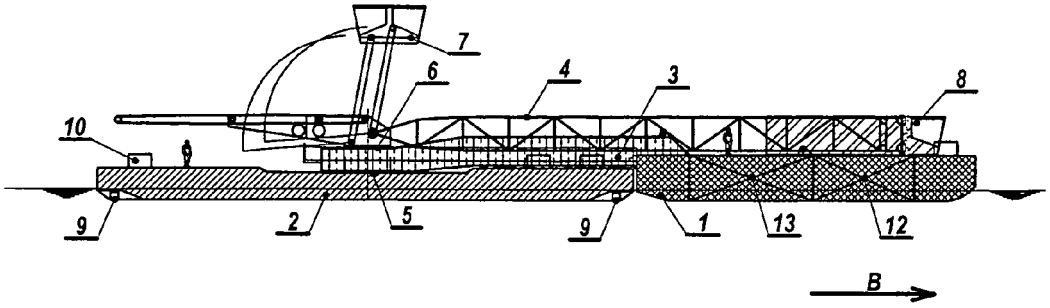


Fig. 3

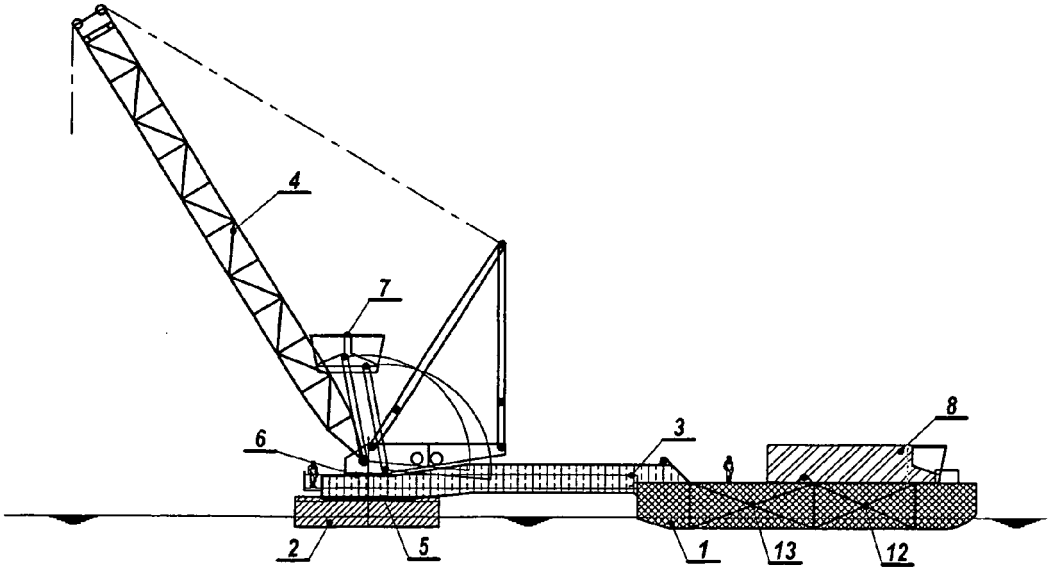


Fig. 4

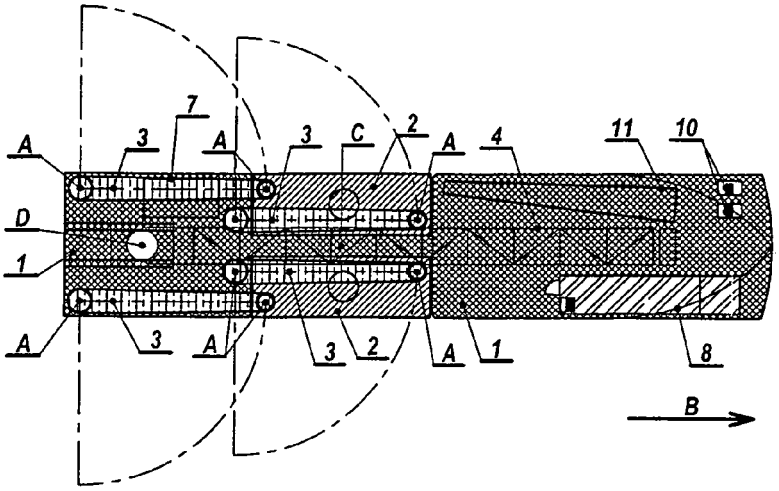


Fig. 5

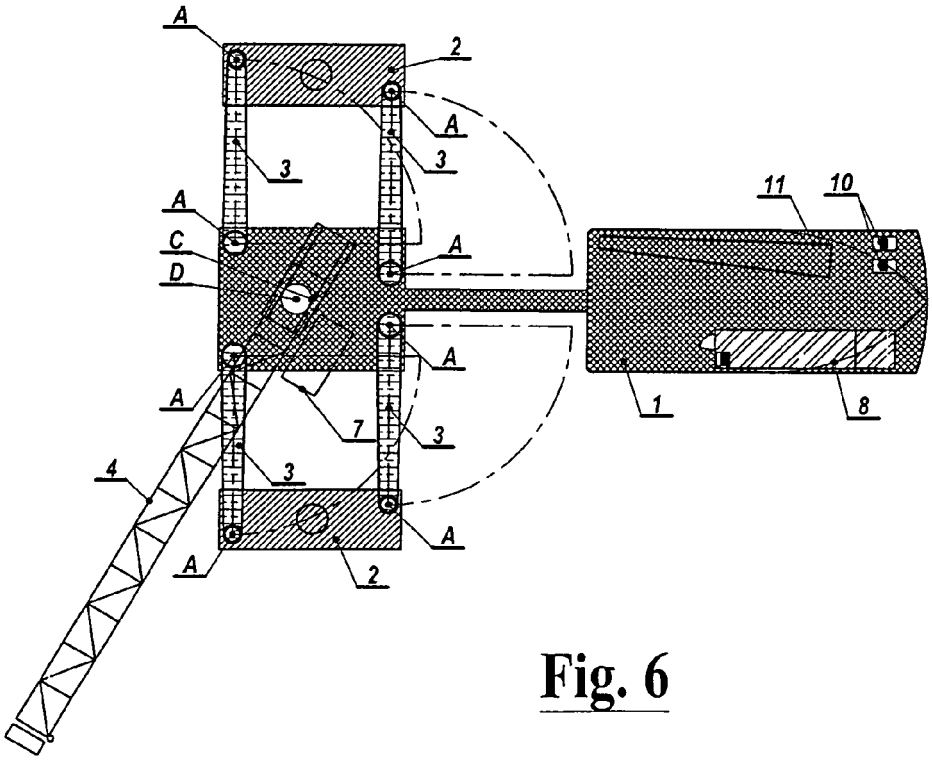


Fig. 6

Europäisches Patentamt
European Patent Office
Office européen des brevets

# EUROPEAN SEARCH REPORT

Application Number
EP 12 46 0093

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br>A | KR 2011 0017961 A (KOREA ADVANCED INST SCI & TECH [KR]) 23 February 2011 (2011-02-23)<br>* figures 3a,3b,6c,8a * | 1-5, 11-14<br>6 | INV.<br>B66C23/53<br>B63B1/14 |
| A | DE 20 2012 009930 U1 (HAGEN PETER [DE])<br>7 November 2012 (2012-11-07)<br>* the whole document * | 1 | |
| A | US 2003/033967 A1 (HAYMAN W ZACK [US])<br>20 February 2003 (2003-02-20)<br>* figure 9 * | 1 | |

TECHNICAL FIELDS SEARCHED (IPC)

B66C
B63B
E02F

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 27 March 2013 | Fiorani, Giuseppe |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 46 0093

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-03-2013

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| KR 20110017961 A | 23-02-2011 | NONE | |
| DE 202012009930 U1 | 07-11-2012 | NONE | |
| US 2003033967 A1 | 20-02-2003 | NONE | |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description


- WO 2007091042 A **[0003]**
- WO 2008142578 A **[0004]**
- WO 2010111061 A **[0005]**
- US 4569453 A **[0006]**
- PL 120236 **[0007]**