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(72) Inventors:
• **Nieuwenhuis, Gijsbert**
2131 BE Hoofddorp (NL)
• **Dorresteijn, Jacob Jan**
2012 DP Haarlem (NL)

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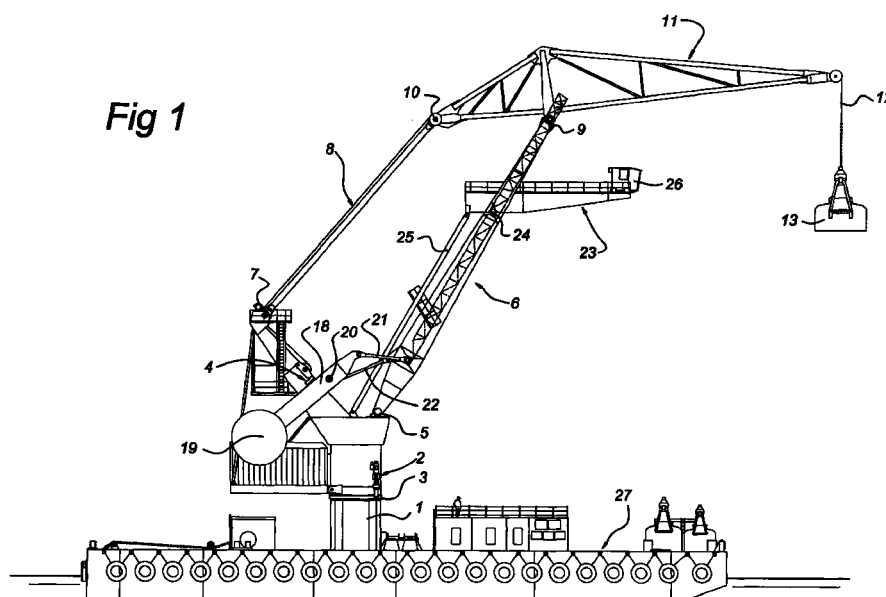
(74) Representative:
Jorritsma, Ruurd et al
Nederlandsch Octrooibureau
Scheveningseweg 82
P.O. Box 29720
2502 LS Den Haag (NL)

(71) Applicant: **Figee B.V.**
2003 RM Haarlem (NL)

(54) **Crane**

(57) A crane, comprising a foot provided with a turntable by means of which a crane base is rotatably supported, a front boom and a rear strut which are attached to the crane base some distance apart about parallel axes of rotation orientated transversely to the axis of rotation of the turntable, a top boom, the rear end of which is attached to the rear strut such that it can pivot about an axis of rotation parallel to the axes of rotation on the crane base, the front boom being attached to said top boom, between the rear end and the front end, such that it can pivot about an axis of rotation parallel to

the axis of rotation at the rear end, balancing means which interact with at least one of the boom and strut and a hoist line suspended from the front end. The front boom and the pivot joints thereof with the top boom and the crane base are designed to transmit compressive forces and torque and the rear strut and/or at least one of the pivot joints thereof with the top boom and the crane base are designed to transmit essentially only tensile forces.



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Description

[0001] The invention relates to a crane, comprising a foot provided with a turntable by means of which a crane base is rotatably supported, a front boom and a rear strut which are attached to the crane base some distance apart about parallel axes of rotation orientated transversely to the axis of rotation of the turntable, a top boom, the rear end of which is attached to the rear strut such that it can pivot about an axis of rotation parallel to the axes of rotation on the crane base, the front boom being attached to said top boom, between the rear end and the front end, such that it can pivot about an axis of rotation parallel to the axis of rotation at the rear end, balancing means which interact with one of the booms and a hoist line suspended from the front end.

[0002] A crane of this type is known and is also referred to as a lemniscate crane after the movement executed by the top boom thereof. The crane can in particular be used as a floating crane for unloading ships carrying a bulk load such as coal, iron ore and the like.

[0003] The known crane has a front boom and a rear strut which are both constructed as arms which are rigid with respect to bending. As a consequence thereof both arms play a role in transmitting horizontal transverse loadings on the top boom to the crane base. Such a construction is fairly heavy and, as a consequence of the rigidity of the two arms, can give rise to problems which are associated with the correct mutual alignment of the various pivot joints.

[0004] The aim of the invention is to provide a crane of such a type which does not have these disadvantages. This aim is achieved in that the front boom and the pivot joints thereof with the top boom and the crane base are designed to transmit compressive forces and torque and the rear strut and/or at least one of the pivot joints thereof with the top boom and the crane base are designed to transmit essentially only tensile forces.

[0005] The front boom of the crane according to the invention is constructed as a torsion arm that is so rigid that it is able fully to absorb the horizontal transverse loadings exerted on the top boom and moments resulting therefrom. The rear strut, on the other hand, does not play any part in transmitting these transverse loadings. Such a construction leads to a lower total crane weight and is also less complex in respect of the alignment of the pivot shafts.

[0006] In order to obtain the desired torsion stability in the pivot joint, the front boom preferably has a lower widened or fork-shaped end, the two ends or fork legs of which each have a bearing by means of which the front boom is pivotably attached to the crane base.

[0007] Furthermore, in this context the front boom can preferably also have an upper widened or fork-shaped end, the two ends or fork legs of which each have a bearing by means of which the front boom is pivotably attached to the top boom.

[0008] In order to prevent the rear strut from partic-

ipating in transfer of torsion, this arm has only a single bearing unit at at least one end, by means of which bearing unit said arm is attached to the crane base and/or to the top boom. Such a bearing unit can comprise a ball joint bearing. The other bearing unit can be a torsionally rigid bearing unit. The advantage of this is that the rear strut always has a defined position and is not able freely to turn about its own longitudinal axis. This can be important if this arm carries guides for the hoist line or, for example, a stairway or platform.

[0009] According to the invention the rear strut can be constructed in various ways. In a first variant this can be a torsionally slack arm. This can be provided with one or two torsionally rigid pivot joints. Torsionally slack pivot joints are also possible with such a rear strut.

[0010] According to a second alternative the rear strut can be a torsionally rigid arm, one or both pivot joints of which are torsionally slack.

[0011] Furthermore, balancing means are provided which are attached to the front boom. The front boom already has a rigid construction per se in connection with the fact that this arm has to absorb the torsional loadings. Consequently this arm is particularly suitable for absorbing balancing forces and moments. Said balancing means can comprise at least one balance arm which is pivotably mounted, between the two ends, on the crane base about an axis of rotation parallel to the axes of rotation of the front boom and rear strut, which balance arm is joined at one end to one of said boom and strut and carries a balance weight at the other end.

[0012] The balance arm can be pivotably joined to the front boom via a coupling rod provided with a pivot joint at both ends.

[0013] In order to increase the stability, two balance arms are provided which are arranged symmetrically with respect to the turntable and each of which carries its own balance weight.

[0014] Preferably, the crane base has a tower which extends obliquely upwards to the rear, the rear strut being attached to the free end thereof.

[0015] A cab boom is pivotably attached to the front boom. A cab for the operator is located at the front end of said cab boom and a tie bar is pivotably attached to the rear end thereof, which tie bar is also pivotably attached to the crane base such that a parallelogram guide is formed with the front boom.

[0016] The invention will be explained in more detail below with reference to an illustrative embodiment shown in the figures.

Figure 1 shows a crane according to the invention in the position in which it is extended forwards.

Figure 2 shows the crane in the retracted position.

Figure 3 shows a front view of the crane.

[0017] The crane shown in the figures comprises a foot 1 on which the crane base 2 is rotatably supported by means of turntable 3.

[0018] The crane base has a tower 4 which extends upwards and to the rear. The front boom 6 is pivotably supported on the crane base by means of bearings 5. The rear strut 8 is pivotably supported at the end of the tower 4 by means of bearings 7.

[0019] The front boom 6 and the rear strut 8 are likewise pivotably attached to the top boom 11 at their upper ends by means of bearings 9 and 10, respectively. The hoist line 12, with the grab 13 thereon, is supported at the end of the top boom 11 by means of a hoisting installation, no further details of which are given.

[0020] As shown in Figure 3, the front boom 6 is provided at the bottom end thereof with a fork-shaped end 14 which has two fork legs 15 angled away from one another. Each of the fork legs 15 is attached to the crane base 2 by means of a bearing 5.

[0021] The front boom 6 is also provided at its top end with a fork-shaped end 16, with two fork legs 17 angled away from one another. Said fork legs 17 support the top boom 11 by means of the bearings 9.

[0022] The front boom 6 is of a torsionally rigid construction. In view of this torsion construction and the fork-shaped ends 14, 16, the front boom 6 is able fully to absorb transverse loadings on the top boom 11, which give rise to a torsional load in the front boom 6.

[0023] In other words, the rear strut 8 takes no or virtually no part in the transmission of these transverse stresses to the top boom 11. The rear strut 8 can therefore be constructed as a tensile strut. One of the bearings 7, 10 can be constructed as a ball joint; the other bearing can be torsionally rigid in connection with positioning of the rear strut 8.

[0024] In connection with balancing of the booms and strut 6, 8, 11, two balance arms 18 are provided, at the end of each of which a balance weight 19 is located. The balance arms are pivotably attached to the fixed arm 4 about pivot shaft 20.

[0025] Each balance arm 18 is joined to the front boom 6 by means of a coupling rod 21.

[0026] Adjustment of the position of the booms and strut 6, 8, 11 is achieved by means of the hydraulic piston/cylinder devices 22, which at one end are attached to the front boom 6 and at the other end are attached to the fixed structure 4.

[0027] A cab boom 23 is also pivotably attached to the front boom. Said cab boom 23 is attached, at that end thereof which extends towards the rear with respect to the pivot joint 24, to a tie bar 25 which runs parallel to the front boom 6.

[0028] The cab boom 23 is thus able to move with the booms and strut 6, 8 and 11 by means of a parallelogram suspension, such that the operator in the cab 26 located at the front of said cab boom 23 always has a good view of a load to be unloaded.

[0029] The crane is accommodated on a pontoon, indicated in its entirety by 27, which is known per se and will not be further described.

Claims

1. Crane, comprising a foot (1) provided with a turntable (3) by means of which a crane base (2) is rotatably supported, a front boom (6) and a rear strut (8) which are attached to the crane base (2) some distance apart about parallel axes of rotation (5, 7) orientated transversely to the axis of rotation of the turntable (3), a top boom (11), the rear end of which is attached to the rear strut (8) such that it can pivot about an axis of rotation (10) parallel to the axes of rotation (5, 7) on the crane base (2), the front boom (6) being attached to said top boom (11), between the rear end and the front end, such that it can pivot about an axis of rotation (10) parallel to the axis of rotation (9) at the rear end, balancing means (18-21) which interact with at least one of the booms (6) and strut (8) and a hoist line (12) suspended from the front end, characterised in that the front boom and the pivot joints thereof with the top boom and the crane base are designed to transmit compressive forces and torque and the rear strut and/or at least one of the pivot joints thereof with the top boom and the crane base are designed to transmit essentially only tensile forces.
2. Crane according to Claim 1, wherein the front boom has a lower widened or fork-shaped end (14), the two ends or fork legs (15) of which each have a bearing (5) by means of which the front boom (6) is pivotably attached to the crane base (7).
3. Crane according to Claim 1 or 2, wherein the front boom (6) has an upper widened or fork-shaped end (16), the two ends or fork legs (17) of which each have a bearing (9) by means of which the front boom (6) is pivotably attached to the top boom (11).
4. Crane according to one of the preceding claims, wherein the rear strut (8) has a bearing unit (7, 10) at both ends, by means of which said arm (8) is attached to, respectively, the crane base (2) and the top boom (11).
5. Crane according to Claim 4, wherein at least one of the bearing units (7, 10) of the rear strut (8) comprises a ball joint bearing.
6. Crane according to one of the preceding claims, wherein the balancing means (18 - 21) comprise at least one balance arm (18) which is pivotably mounted, between the two ends, on the crane base (2) about an axis of rotation parallel to the axes of rotation of the front boom (6) and rear strut (8), which balance arm (18) is joined at one end to the front boom and carries a balance weight (19) at the other end.

7. Crane according to Claim 6, wherein at least one balance arm (18) is pivotably joined to the front boom (6) via a coupling rod (21) provided with a pivot joint at both ends.

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8. Crane according to Claim 6 or 7, wherein two balance arms (18) are provided which are arranged symmetrically with respect to the turntable (3) and each of which carries its own balance weight (19), and each of which is joined to the front boom (6) by means of its own coupling rod (21).

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9. Crane according to one of the preceding claims, wherein the crane base (2) has a tower (4) which extends obliquely upwards to the rear, the rear strut (8) being attached to the free end thereof.

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10. Crane according to one of the preceding claims, wherein a cab boom (23) is pivotably attached to the front boom (6), a cab (26) for the operator being located at the front end of said cab boom and a tie bar (25) being pivotably attached to the rear end thereof, which tie bar (25) is also pivotably attached to the crane base (2) such that a parallelogram guide is formed with the front boom (6).

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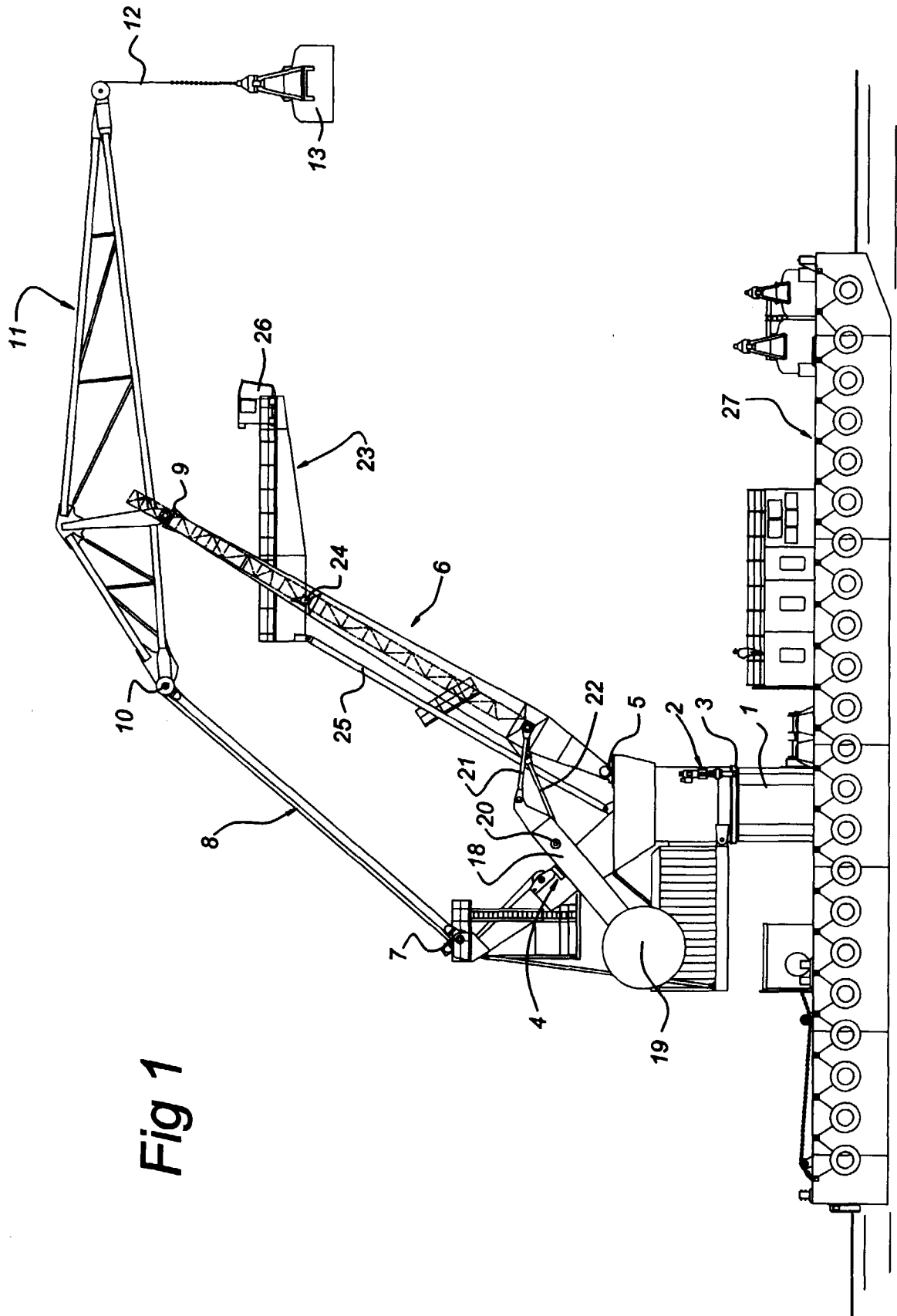


Fig 2

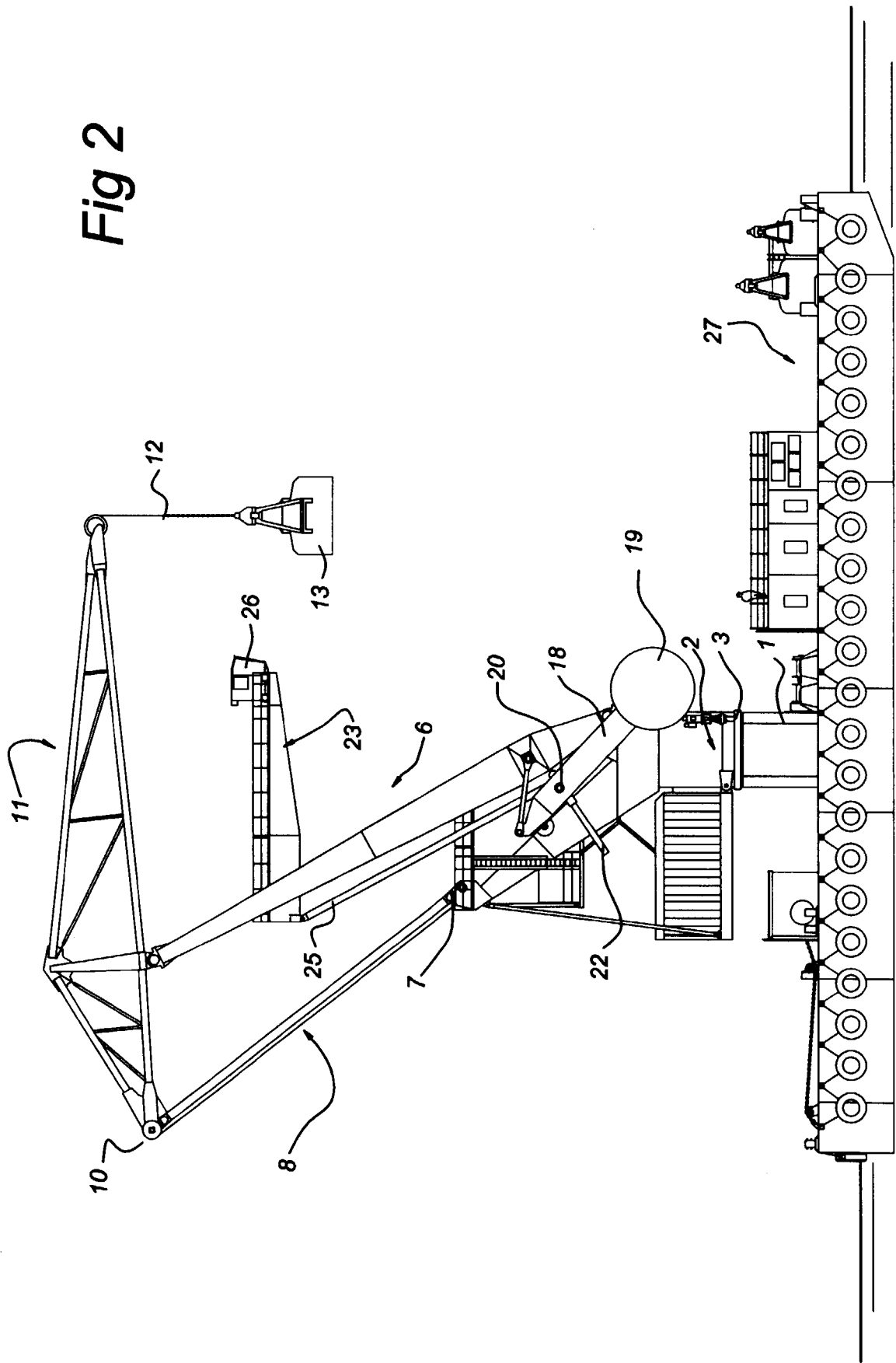
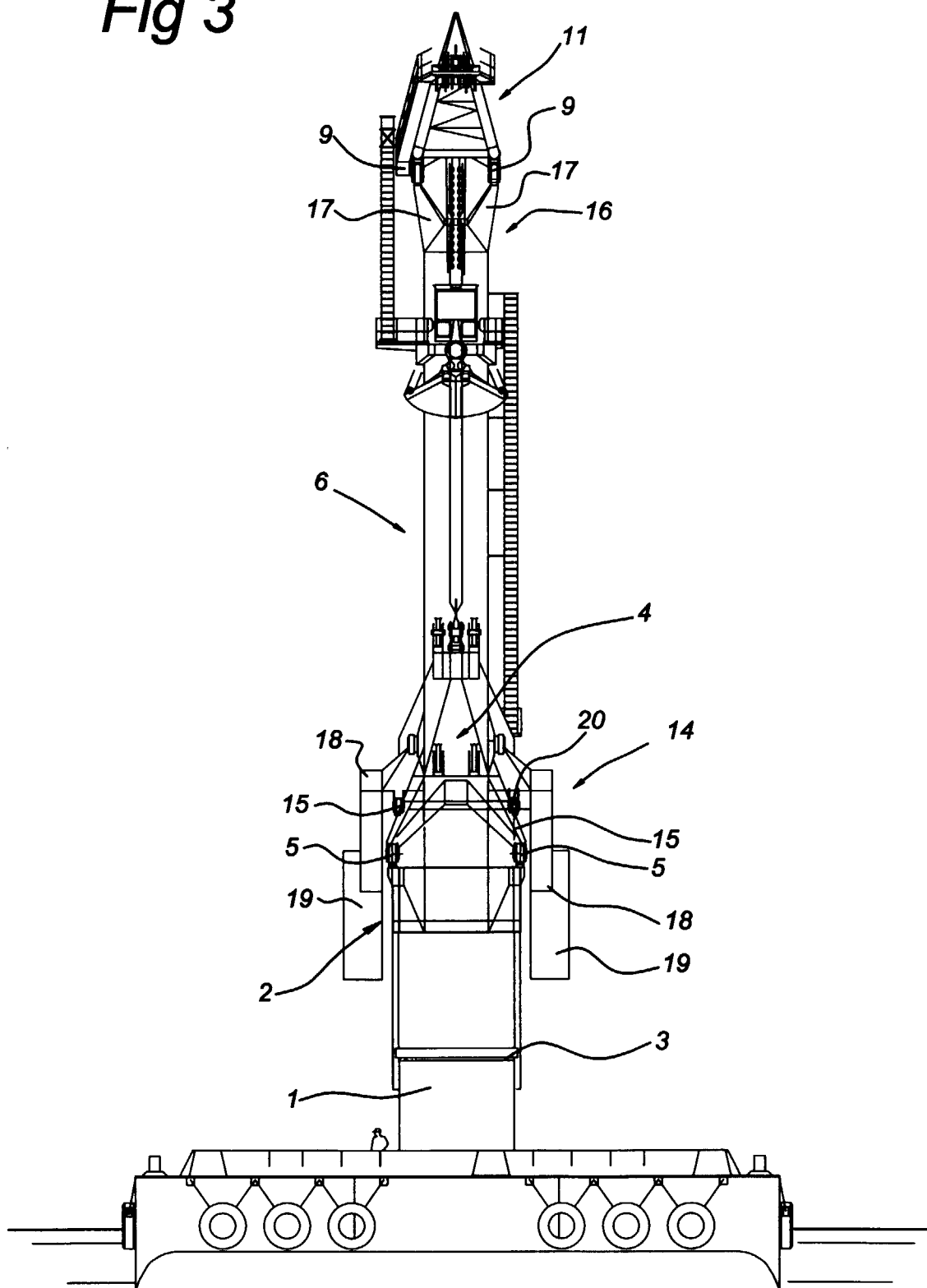


Fig 3





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EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1522

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 653 656 A (TRIPLETT) 31 March 1987 (1987-03-31)	1,2,4,5,9	B66C23/52
Y	* column 3, line 16 - column 5, paragraph 5; figures 1-3 *	6	
Y	BE 493 548 A (DEAG AG) * page 2, line 21 - line 52; figure 1 *	6	
A	WO 89 10892 A (AMCA INTERNATIONAL CORP.) 16 November 1989 (1989-11-16) * page 5, line 17 - page 7, paragraph 2; figure 1 *	7,8,10	
A	US 4 081 932 A (ARMSTRONG) 4 April 1978 (1978-04-04) abstract	1,2	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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Place of search THE HAGUE		Date of completion of the search 25 July 2000	Examiner Herbreteau, D
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
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