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(54) Crane relocation and erection.

(57) Crane (1) for loading and unloading goods, particularly containers, into and from a ship, respectively, comprising a superstructure and a substructure supporting said superstructure (2, 2'), wherein said substructure (3) is to be provided with means for positioning the crane on a basis, e.g. a quay, and has structure members extending substantially vertically, and wherein said superstructure comprises a bridge structure (19) such as a trolley girder, including structure members extending substantially horizontally, and further comprising means (37b) for attachment of said superstructure on said substructure, wherein said attachment means (37b) are releasable and are located in the lower part of the substructure (3) so that the bridge structure (19) is located in the lower part of the crane. The crane of the invention is easier to transport on deck of a transport vessel due to the low position of the superstructure.

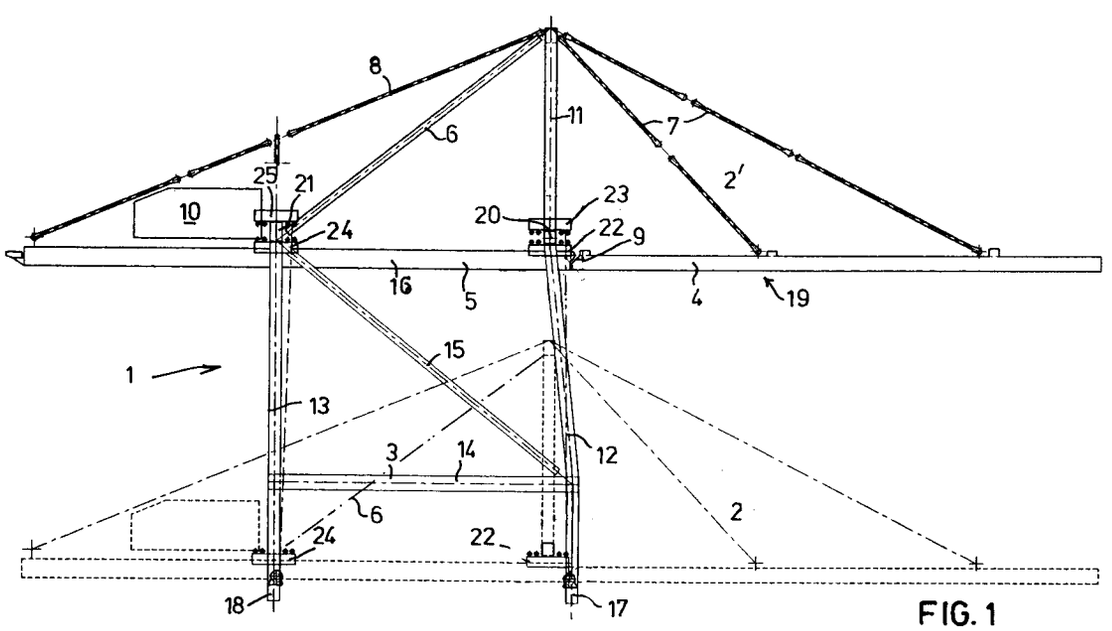

FIG. 1

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The invention relates to a crane as well as a method of transporting and installing such a crane.

Cranes that are designed and constructed for use in harbour areas for loading and unloading goods into and from a ship moored to a quay have increasingly large dimensions. This is particularly the case for cranes that are equipped for handling containers or mass goods such as ore. Especially in the design of container cranes time and again stricter requirements with respect to the size and handling capacity have to be met. One may recall the first generation container cranes being already relatively considerably large structures. Nowadays, a seventh generation container cranes is being built surpassing by far the first generation container cranes in size.

The ever increasing size of new cranes, although supplying an important need, makes the handling of the cranes more complicated. Usually new cranes are assembled at their location of manufacture and subsequently transported to a harbour by a transport vessel, and finally arranged on the right spot on the quay of that harbour. Already during the assemblage of the crane the superstructure of the crane, comprising a bridge structure such as a trolley girder, including structure members extending substantially horizontally, will be mounted at the same position or level that it takes when being used on the quay, i.e. on top of the substructure of the crane. As a consequence, during transport by the transport vessel, the crane structures fastened on the deck of the transport vessel will project high above said deck. As a result, the stability of the crane during transport is a source of concern, and dynamic forces acting on the crane during its transportation may take dangerous proportions.

A main object of the invention is to provide a crane as well as a method of transporting and installing such a crane which offer a solution to the above problematical circumstances.

To that end, the invention provides a crane for loading and unloading goods, particularly containers, into and from a ship, respectively, comprising a superstructure and a substructure supporting said superstructure, wherein said substructure is to be provided with means for positioning the crane on a basis, e.g. a quay, and has structure members extending substantially vertically, and wherein said superstructure comprises a bridge structure such as a trolley girder, including structure members extending substantially horizontally, and further comprising means for attachment of said superstructure on said substructure, characterized in that said attachment means are releasable and are located in the lower part of the substructure so that the bridge structure is located in the lower part of the crane.

The crane of the invention is designed in such a way that the complete superstructure or topside can be mounted at a lower level than that of its final operation position. Thus, at the location of manufacture the crane is assembled with the bridge structure in the lower part of the crane. In this arrangement the crane is transported to a harbour by a transport vessel. Since the centre of gravity of the crane will be located at a level that is far beneath the level of a crane fully erected, the stability of the crane on deck will be improved to a great extent. Moreover, due to the sort of collapsed state of the crane, dynamic forces that are borne on the wind and act on the crane will be reduced. After the transport vessel has been moored to the quay of destination, the crane is landed, whereupon the attachment between the topside and the substruc ture is released and the topside is lifted by any suitable means up to its working postition on top of the substructure and secured at this place by any proper securing means, such as the usual welds.

The crane of the invention may be erected on the quay of destination by means of floating cranes. It will be clear that the increasing sizes of the container cranes require larger constructions of these floating cranes, which will be very costly and may have to be taken care of time each time a new generation container cranes is introduced. Furthermore, this method requires the presence of such large floating cranes on the spot. In order to put an end to the need for floating cranes of the proper size for the actual installation of the crane of the invention which is very hard to fulfill in less developed harbours, the crane of the invention would preferably have hoisting means to be used for vertically displacement of said superstructure relative to said substructure after release of said attachment means towards a position wherein said superstructure is located at the top of the substructure. Preferably, said hoisting means comprise hoisting cable sheave means for engagement by and guidance of hoisting cable means engaging said superstructure and being connected at one end to a hoisting winch means. The other end of the cable will be fastened to the superstructure or the substructure, depending on the chosen lay-out of the hoisting mechanism.

It would be favourable if the crane is already provided with suitable sheave means so that it is only necessary to have a set of cables and a set of winches available at the quay of destination of the crane. Nevertheless, winches, cables, and sheaves might be mounted onto the crane as early as its first assemblage prior to transport so as to make the crane more or less self-supporting with respect to its erection.

The invention also relates to a method according to which the crane of the invention is transported on deck of a transport vessel.

According to one particular embodiment of the invention, the method is related to preparing a crane for transport and subsequent transport of that crane, in particular a container crane, and comprises a superstructure provided with a bridge structure such as a trolley girder, and a substructure for supporting said superstructure, wherein said superstructure is releasably attached to said substructure at a location in the lower part of said substructure, and subsequently said crane is placed on deck of a transport vessel and said vessel is set to sail.

Preferably, at least two cranes are prepared for simultaneous transport on a same transport vessel, wherein the superstructure of one crane is releasably attached to its substructure at a level that is different from the level at which the superstructure of the other adjacent crane is releasably attached to its substructure. In this way, the substantially horizontally extending structure members of the lowered superstructures of adjacent cranes stored on deck may partly overlap one another so as to enable these cranes to be placed close to one another, thus saving space.

According to another embodiment, the method of the invention is related to the transport of a crane and subsequent installation of that crane, in particular a container crane, comprising a superstructure provided with a bridge structure such as a trolley girder, and a substructure for supporting said superstructure, said superstructure having been releasably attached to said substructure by a releasable attachment at a location in the lower part of said substructure, said crane having been stored on deck of a transport vessel, wherein the method comprises the following stages:

a) said transport vessel with the crane on deck is sailed to a quay or a similar structure;

b) said crane is transferred to a location on said quay;

c) said releasable attachment is released;

d) said superstructure is lifted from its initial lower position with respect to said substructure towards an upper position at the upper side of said substructure; and

e) said superstructure is fastened to said substructure.

Preferably, in step d) said superstructure is guided by said substructure during lifting. Said lifting is preferably carried out by using hoisting cable sheave means on said substructure and/or said superstructure, hoisting winch means and hoisting cable means connected at one end to said superstructure or said substructure and at the other end to the hoisting winch means.

Since the above methods of the invention apparently overlap one another, it may be advanteageous to combine them to constitute a method for preparing a crane for transport, followed by transport of said crane and subsequent installation of that crane, in particular a container crane, comprising a superstructure provided with a bridge structure such as a trolley girder, and a substructure for supporting said superstructure, comprising the following stages:

a) said superstructure is releasably attached to said sub structure by a releasable attachment at a location in the lower part of said substructure;

b) said crane is stored on deck of transport vessel;

c) said transport vessel with the crane on deck is sailed to a quay or a similar structure;

d) said crane is transferred to a location on said quay;

e) said releasable attachment is released;

f) said superstructure is lifted from its initial lower position with respect to said substructure towards an upper position at the upper side of said substructure; and

g) said superstructure is fastened to said substructure.

The invention will be illustrated below with reference to the drawings showing a preferred embodiment of the crane of the invention, and wherein:

Figure 1 shows a considerably large, preferred embodiment of the crane of the invention before and after its superstructure has been lifted up to its working level;

Figure 2 is a side view of the crane of figure 1;

Figures 3A and 3B show cross-sectional details along lines IIIA and IIIB in figures 4A and 4B;

Figures 4A and 4B show details of the crane of figures 1 and 2;

Figures 5A, 5B, 5C show cross-sectional details of the connection of the substructure to the superstructure of the crane as illustrated in figure 1;

Figure 6 shows a rigging diagram of the hoisting mechanism of the crane of figure 1; and

Figure 7 shows a transport vessel having two cranes of the invention stored on deck.

The crane of figure 1 comprises a substructure 3 and a superstructure 2, 2' which is depicted in dashed lines when it is in the lowered position to form the crane of the invention (see reference numeral 2) as well as in full lines when it is in lifted, final position on top of the substructure (see reference numeral 2').

Substructure 3 comprises four postmembers or legs 12, 13, i.e. waterside legs 12 and landside legs 13 which are connected to one another at the lower ends by means of transverse or tie beams

14, and moreover, by leg-diagonals 15. The lower ends of the waterside legs 12 are connected to one another by a transverse sill beam 17 and the lower ends of the landside legs 13 are connected to one another by a transverse sill beam 18. Near the connection between the post members 12, 13 and the sill beams 17, 18 roller sets or bogies are to be mounted in order to enable the displacement of the crane in use. On top of the posts 12,13 upper hoisting assemblies 23, 25 are mounted. A more detailed description of this upper hoisting hoisting assembly is given below.

Superstructure 2, 2' comprises a trolley girder 19 (trolley is not shown), including two parallel, horizontally extending beams 16, each of which comprises a landside part 5 and a waterside part or boom 4, which are articulated at 9 in order to enable the boom to be held in a position in which it projects upwardly and is inclined at an angle to the landside part 5. Such an orientation of the boom 4 is advantageous during transport as it permits an adjacent crane to be stored on deck in a position close to the first crane. The super structure 2, 2' also comprises two transversely extending trolley girder support beams 20, 21.

Furthermore, the superstructure 2, 2' comprises an upstanding, so-called "A"-frame 11, which is supported by and fastened to the waterside trolley girder support beam 20 and diagonal support bars 6 extending between the landside trolley girder support beam 21 and the top beam of the "A" frame 11. Furthermore, tension bar strings 7 and 8 are provided which extend from the top beam of the A-frame 11 to the boom 4 and to the outer end of the landside part 5 of the trolley girder 10, respectively so as to suspend the sections of the trolley girder projecting horizontally outwardly from the substructure 3. Lower hoisting assemblies 22, 24 are mounted onto the ends of trolley girder support beams 20, 21, respectively, and are described further below. Finally, the superstructure 2, 2' is provided with a machine house 10 for operating the trolley.

At this point, reference is made to figures 3A and 3B, 4A and 4B. In figure 3A and 4A the upper hoisting assembly mounted onto the upper end of each of the waterside legs 12 is shown. As is shown, a transverse upper spreader 27 carrying four sheave boxes 29 is removably secured to console assembly 36 at 39 and 40, said console assembly 36 being bolted to the upper end of leg 12.

The sheave boxes 29 are bolted to the lower flange of upper spreader 27 and each of them comprises two, three or four parallel, coaxially placed sheaves 31 for cable 40. Near the sheave box 29 at the right hand of figure 3A an additional sheave box 32 having a single sheave is arranged perpendicular to the other sheave boxes 29. The upper spreader 27 projects horizontally out of the circumference of leg 12 so that the sheave boxes 29 have sheaves 31 that are arranged such as to receive a cable extending upwardly from the lower hoisting assembly.

In figures 3B and 4B the lower sheave assemblies 22, 23 are shown which are arranged at both ends of trolley girder support beams 20 and 21, respectively. The lower sheave assembly 22 comprises a lower spreader 26 which is secured to the lower side of support beam 20, on top of which, at either side of the support beam 20, sheave boxes 28 are mounted, each of which comprises two or three parallel, coaxially positioned sheaves 30. The sheaves 28 are arranged such as to lie substantially vertically beneath sheaves 29.

Below the ends of the support beam 20, 21 winch assemblies 33-35 are mounted onto respective ends of sill beams 17, 18. As is shown in figures 3B and 4B, the winch assemblies 33-35 comprise a mounting frame 33 for mounting onto the sill beam, a winch drum 34 rotatably mounted into frame 33 and a motor 35 for rotating winch drum 34. The winch assembly is arranged so as to enable a winch cable to extend substantially vertically up to sheave 32 of the upper hoisting assembly as shown in figures 3A and 4A. In figures 3A and 4B the area in which the cable can extend is indicated by dash lines.

In figure 4B also the trolley girder part 5 is shown which is connected to beam 20 by the mounting part 40 in order to support beam 20 by way of suspension thereof.

At its ends the support beam 20 (as well as support beam 21) is provided with mounting flange 37a which is releasably attached by means of bolts to a mating flange 37b on the inner side of post 12, in the lower part thereof. As is shown in figures 3A and 4A a mounting flange 38b is provided at the upper end of post 12, at the inner side thereof. Mounting flange 38b corresponds to mounting flange 37b, so as to enable an attachment of mounting flange 37a thereto.

Figure 5A, 5B and 5C show vertical cross-sections along lines VA-VA, VB-VB, VC-VC, respectively, of the releasable connection of support 20 to post 12. The flange plate 37a of support beam 20 is attached to flange plates 37b of post 12 by means of bolts 41. To the lower side of the end of support beam 12 pinlike members 44 are fastened which fit into holes 46 provided in support block 45 fastened to the upper side of lower spreader 26. At the side facing the inner side plate 47 of post 12 lower spreader 26 is provided with a recess 48 in which a roller 42 is rotatably mounted. Inner side plate 47 is strengthened by a transverse plate 43.

In figure 6 the rigging diagram is shown in the arrangement at the end of lifting or hoisting operations. Cables 50 are attached to winches 34 at one end and wound up on the winch by the operation of motors 35 until the flanges 37a have reached a position facing flanges 38b. In that position the upper side of support beams 20, 21 may abut the lower side of upper spreader 27 so as to facilitate the positioning thereof. As is illustrated, cables 50 are guided upwards and downwards etc. between the lower sheaves 30 and the upper sheaves 31 and are finally fastened at 49 to the upper end of posts 12, 13.

When assembling the crane of the invention the support beams 20, 21 are fastened with therein flanges 37a being connected to flanges 37b on posts 12, 13. Due to the low level of the flanges 37b this operation can be easily performed, even if very large superstructures are involved.

After the boom 4 of the crane has been tilted up to a more upward sloping orientation, the crane of the invention would already permit transportation by a transport vessel, e.g. the dock ship as shown in figure 7. In that case hoisting means could be mounted only at the destination and removed again after completion of the lifting operation.

It may, however, be advantageous to equip the crane with the complete hoisting mechanism or parts of it prior to its transportation. Thus, the upper spreaders 27 with sheaves 31 are mounted on top of the posts 12, 13, the lower spreaders 26 with sheaves 30 are placed somewhere on deck, and the winches 33-35 are mounted on sill beams 17, 18. Cables 50 may or may not have been rigged already through the sheaves. At the destination the crane is embarked by moving it along the outriggers at the stern of the dock ship of fig. 7. When the crane is in the correct place the lower spreaders 26 with sheaves 30 and bearing block 45 on their upper side are positioned below the ends of support beam 20, 21 so that pins 44 are inserted into holes 46 in bearing blocks 45. Subsequently the rigged cable is tightened by operating the winches in such a way that the cables are able to take over the weight of the superstructure 2 during the removal of the bolts, so as to permit disconnection of the flanges 37a from the flanges 37b. Following that, the hoisting operation can be performed until the flanges 37a are at a level permitting their attachment to flanges 38b at the upper ends of posts 12, 13. During the lifting operation vertical, downwardly directed forces are exerted on the upper ends of posts 12, 13 at the sheaves 32, as a result of which a bending moment (see Arrow A in fig. 4A) is exerted on posts 12, 13. Consequently, the upper parts of posts 12, 13 will bend inwardly, so that intermediate space between the landside legs 13 as well as the intermediate space between waterside legs 12 will be reduced to such an extent that the support beams 20, 21 would have problems to reach their upper position. The main function of roller 42 is to exert a horizontal force on the inner sides of the legs 12, 13, so that the displacement resulting from the moment A is equalized and the support beams 20 and 21 are given free way in their upward movement.

After flanges 38b and 37b have been bolted together, the lower spreader may be easily removed by paying out the cables 50 again.

Claims

1. Crane for loading and unloading goods, particularly containers, into and from a ship, respectively, comprising a superstructure and a substructure supporting said superstructure, wherein said substructure is to be provided with means for positioning the crane on a basis, e.g. a quay, and has structure members extending substantially vertically, and wherein said superstructure comprises a bridge structure such as a trolley girder, including structure members extending substantially horizontally, and further comprising means for attachment of said superstructure on said substructure, **characterized in that** said attachment means are releasable and are located in the lower part of the substructure so that the bridge structure is located in the lower part of the crane.

2. Crane as claimed in claim 1, comprising hoisting means to be used for vertically displacement of said superstructure relative to said substructure after release of said attachment means towards a position wherein said superstructure is located at the top of the substructure.

3. Crane as claimed in claim 2, wherein said hoisting means comprise hoisting cable sheave means for engagement by and guidance of hoisting cable means engaging said superstructure and being connected at one end to a hoisting winch means.

4. Crane as claimed in 1, 2, 3, wherein the bridge structure is provided with rolling or sliding spacing means, which are located so as to exert a horizontally outward force on the substantially vertically extending structure member of said substructure, at least against the upper part thereof, when the superstructure is lifted towards its position on top of said substructure, said substantially vertically extending structure members being arranged with their top ends being horizontally displaceable with respect to

each other.

5. Method for preparing a crane for transport and subsequent transport of that crane, in particular a container crane, comprising a superstructure provided with a bridge structure such as a trolley girder, and a substructure for supporting said superstructure, wherein said superstructure is releasably attached to said substructure at a location in the lower part of said substructure, and subsequently said crane is placed on deck of a transport vessel and said vessel is set to sail.

6. Method as claimed in claim 5, at least two cranes being prepared for simultaneous transport on a same transport vessel, wherein the superstructure of one crane is releasably attached to its substructure at a level that is different from the level at which the superstructure of the other adjacent crane is releasably attached to its substructure.

7. Method for transport of a crane and subsequent installation of that crane, in particular a container crane, comprising a superstructure provided with a bridge structure such as a trolley girder, and a substructure for supporting said superstructure, said superstructure having been releasably attached to said substructure by a releasable attachment at a location in the lower part of said substructure, said crane having been stored on deck of a transport vessel, wherein the method comprises the following stages:

   a) said transport vessel with the crane on deck is sailed to a quay or a similar structure;
   b) said crane is transferred to a location on said quay;
   c) said releasable attachment is released;
   d) said superstructure is lifted from its initial lower position with respect to said substructure towards an upper position at the upper side of said substructure; and
   e) said superstructure is fastened to said substructure.

8. Method as claimed in claim 7, wherein in step d) said superstructure is guided by said substructure during lifting.

9. Method as claimed in claim 7 or 8, wherein said lifting is carried out by using hoisting cable sheave means on said substructure and on said superstructure, hoisting winch means and hoisting cable means connected at one end to said superstructure or said substructure and at the other end to the hoisting winch means.

10. Method for preparing a crane for transport, followed by transport of said crane and subsequent installation of that crane, in particular a container crane, comprising a superstructure provided with a bridge structure such as a trolley girder, and a substructure for supporting said superstructure, comprising the following stages:

   a) said superstructure is releasably attached to said substructure by a releasable attachment at a location in the lower part of said substructure;
   b) said crane is stored on deck of transport vessel;
   c) said transport vessel with the crane on deck is sailed to a quay or a similar structure;
   d) said crane is transferred to a location on said quay;
   e) said releasable attachment is released;
   f) said superstructure is lifted from its initial lower position with respect to said substructure towards an upper position at the upper side of said substructure; and
   g) said superstructure is fastened to said substructure.

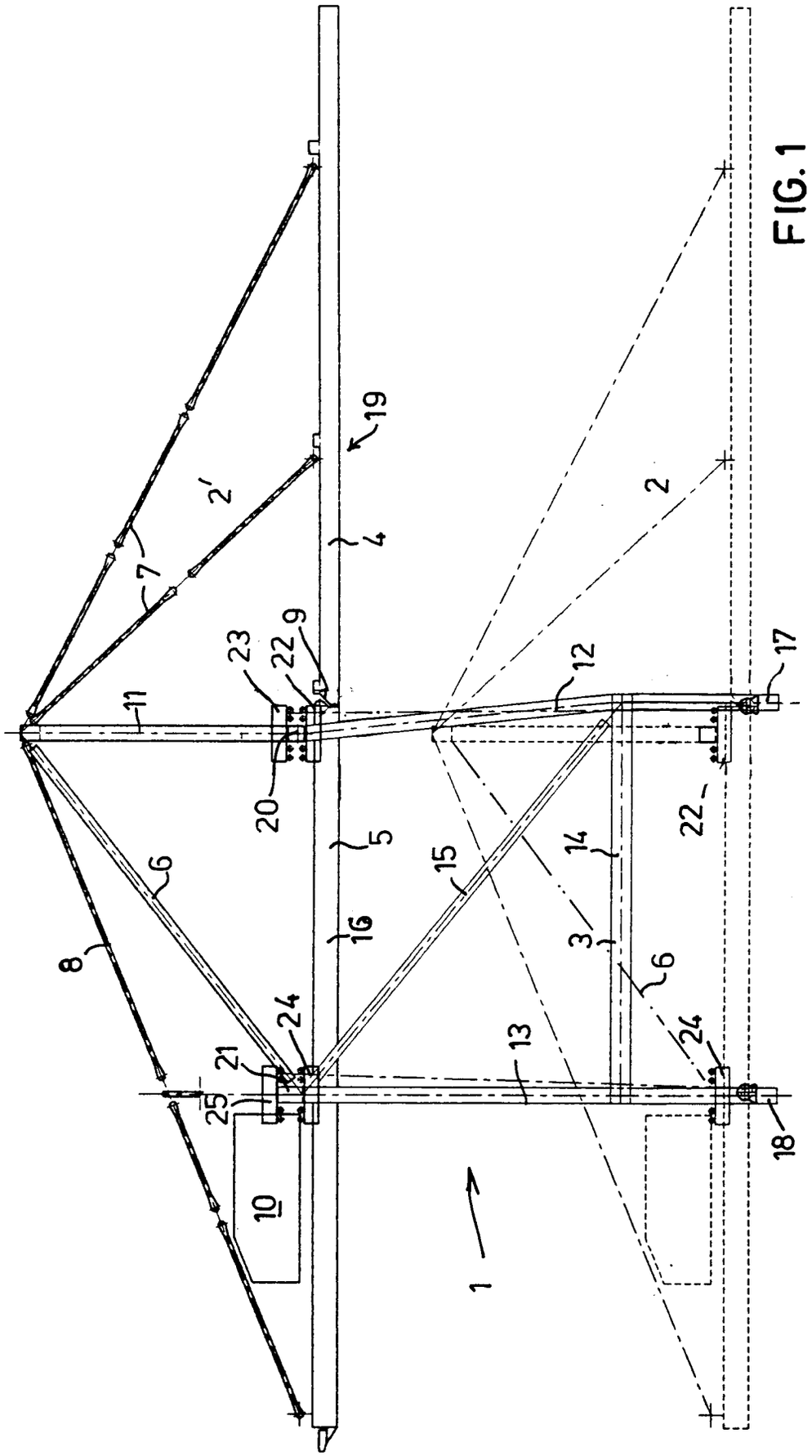
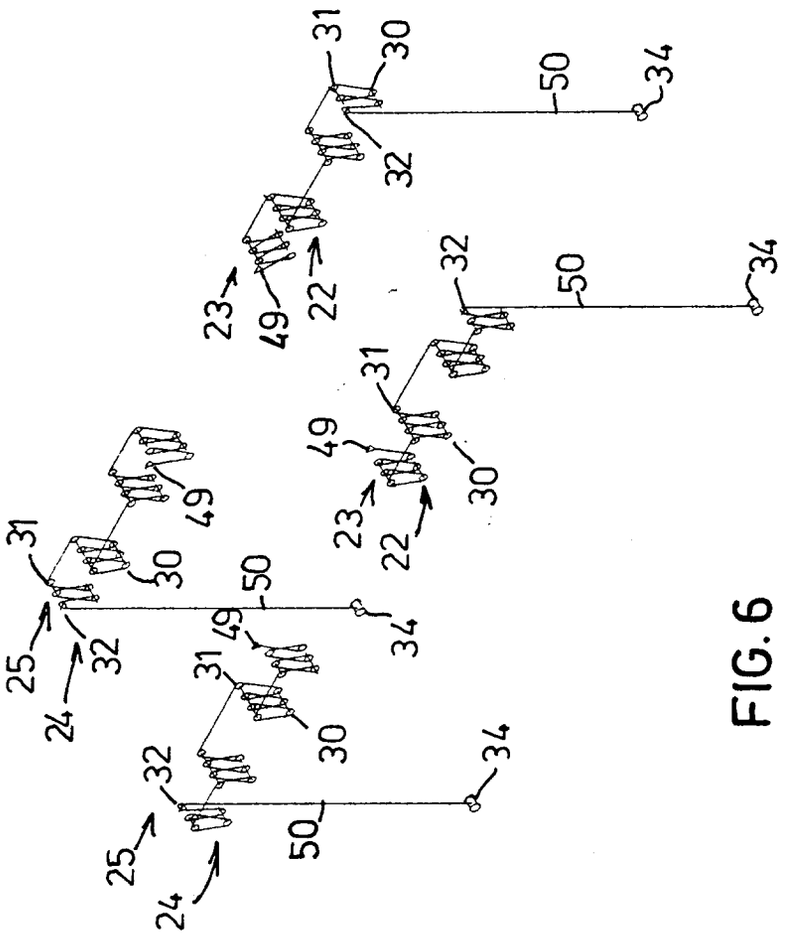
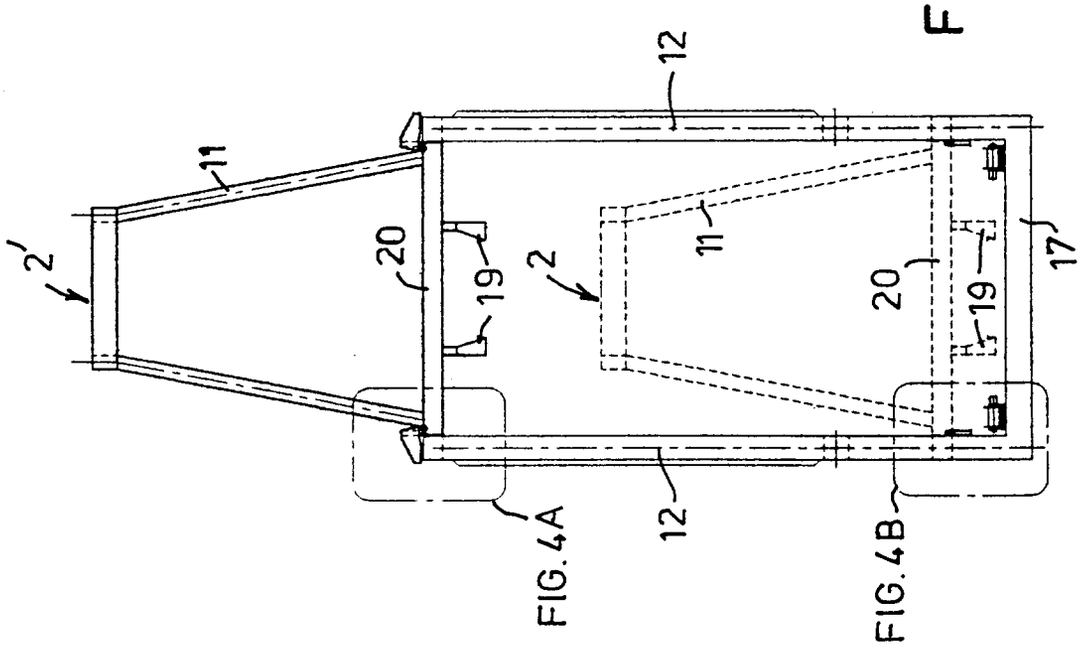


FIG. 1


31
30
50
34
32
23
49
22
25
24
FIG. 6


2'
11
20
19
2
12
17
FIG. 4A
FIG. 4B
FIG. 2

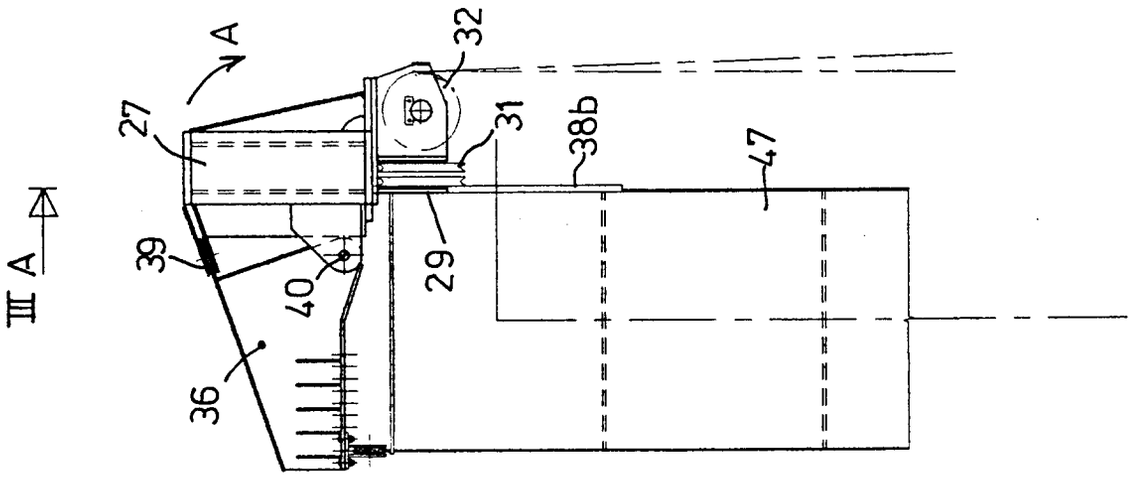

III
A
27
A
32
31
38b
47
39
40
29
36

FIG.4A

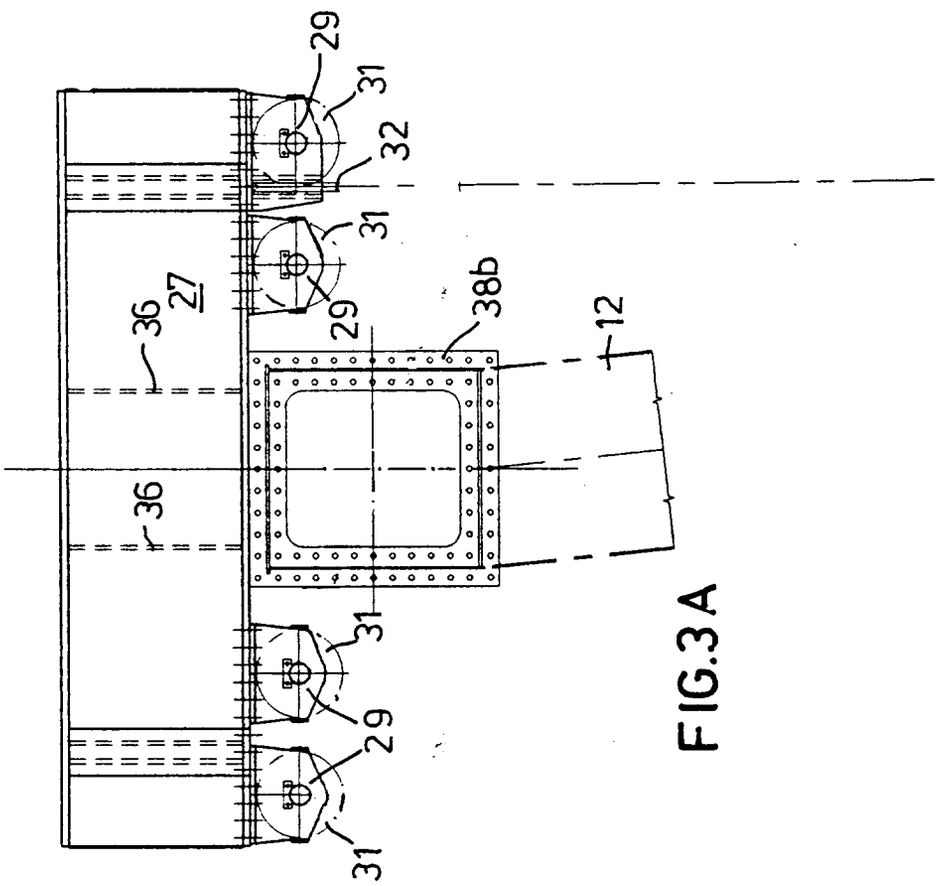

29
31
32
31
27
36
29
38b
12
36
31
29
31

FIG.3A

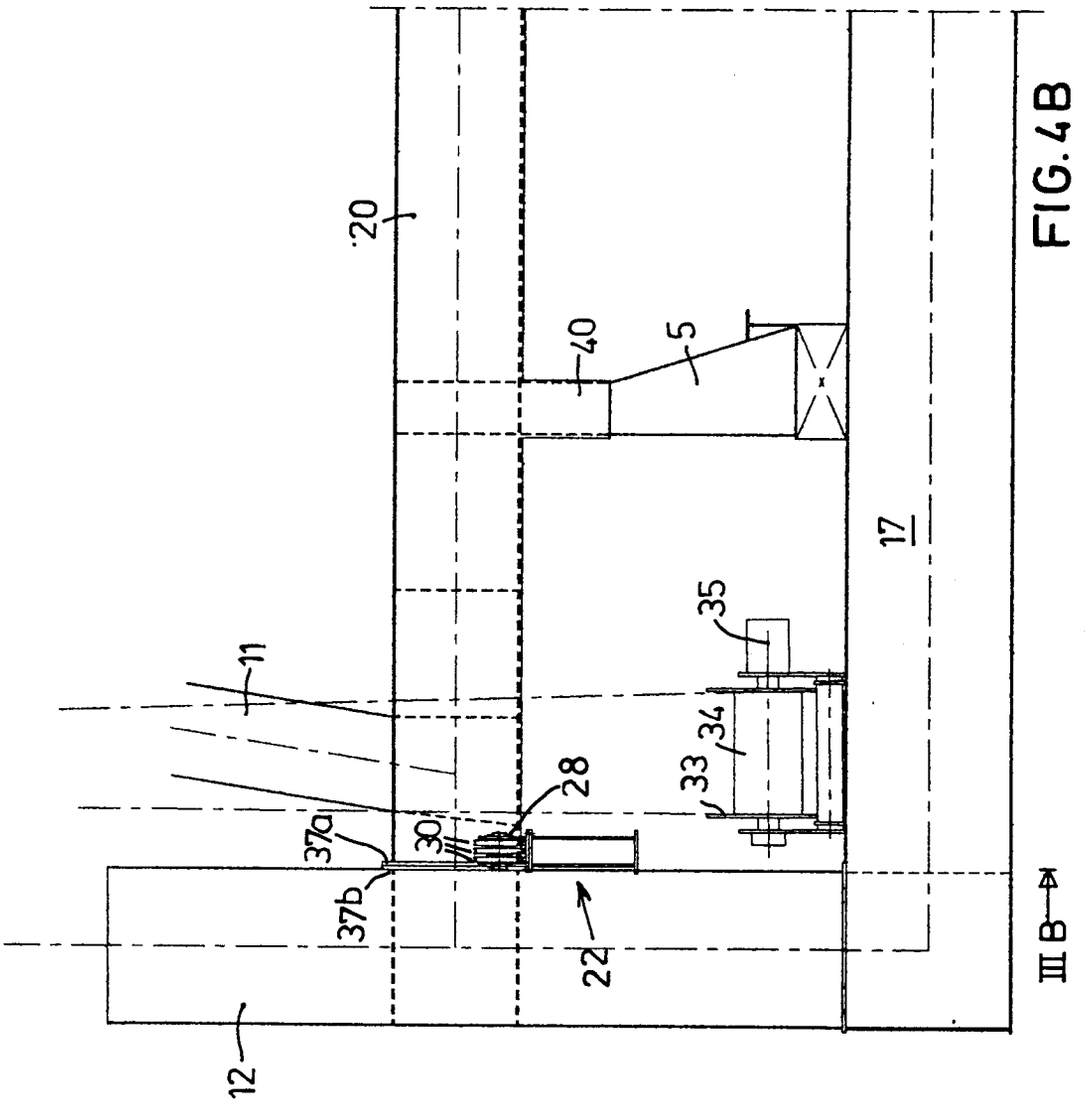

20
40
5
17
35
11
34
33
28
37a
30
37b
22
12
III B

FIG. 4B

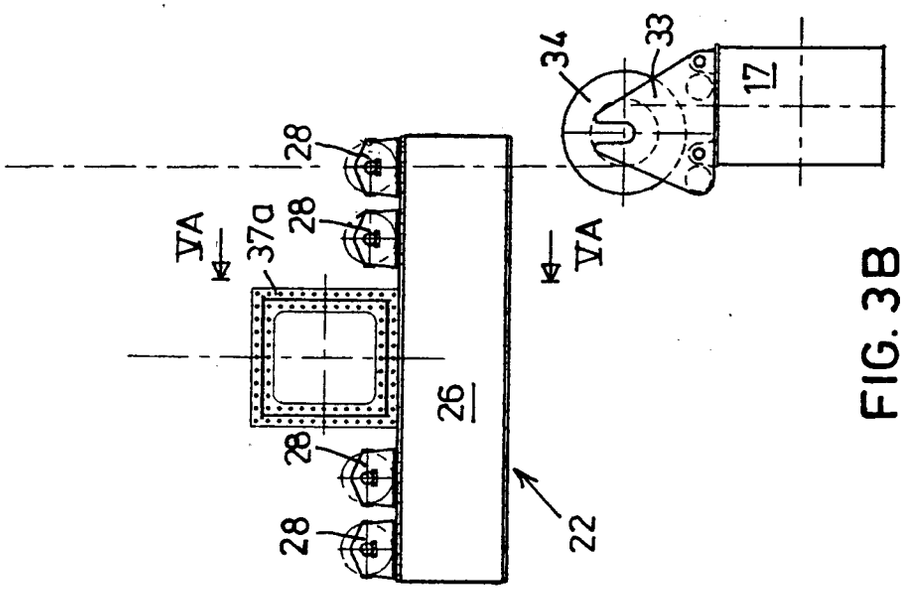

34
33
17
28
VA
37a
28
VA
26
28
28
22

FIG. 3B

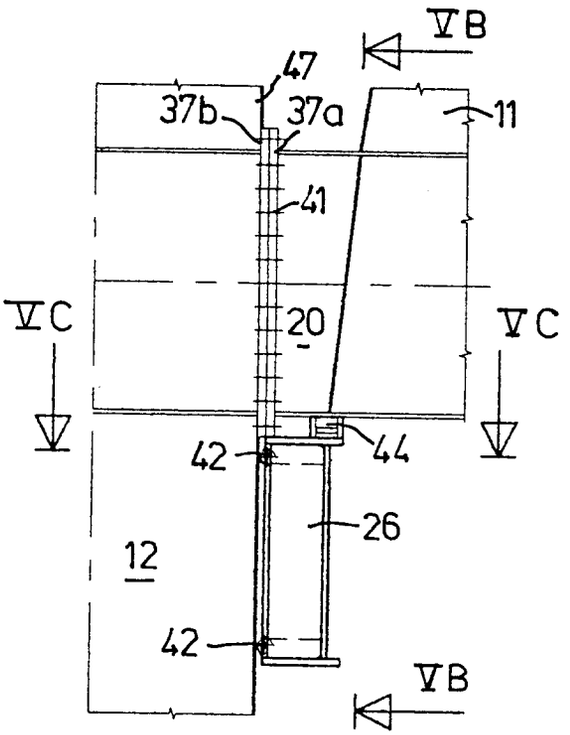


FIG. 5A

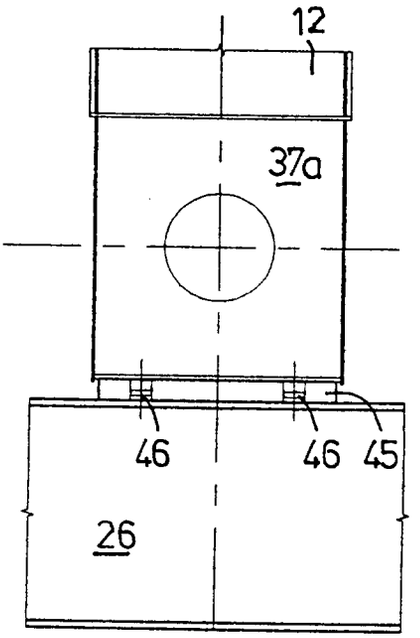


FIG. 5B

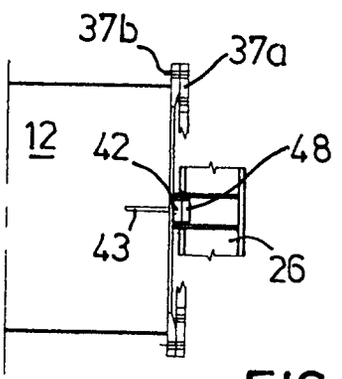


FIG. 5C

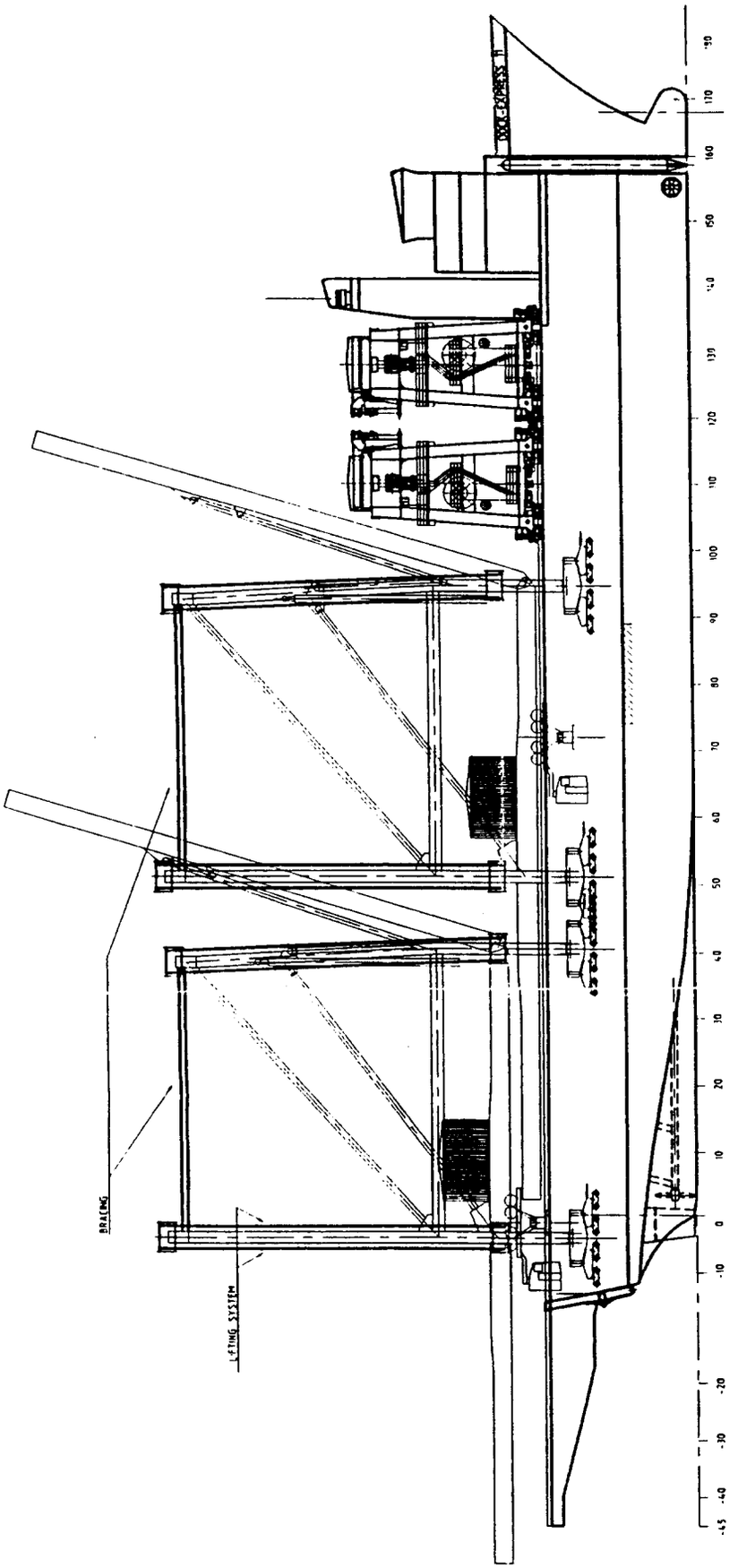


FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 20 0075

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y A	US-A-3 645 405 (STIGLICH) * figures 1-3,13 * * column 1, line 64 - line 65 * * column 2, line 16 - line 55 *	1,2,3 7	B66C19/00
Y	EP-A-0 061 790 (FRANS SWARTTOUW B.V.) * page 4, line 15 - line 23 * * page 4, line 28 - line 32 * * claim 4; figures 1,4 *	1,2,3	
Y A	GB-A-728 472 (NOBLE) * page 5, line 95 - line 122 * * figures 3-7 * * figures 10,11,15-18 *	1,2,3 5	
A	US-A-3 931 778 (MILLER ET AL.) * column 3, line 19 - line 61; figures *	1,2,7	
A	US-A-3 061 112 (BEVARD) * column 4, line 26 - line 47; figures *	1,2,7	
A	DE-A-2 064 978 (PORT AUTONOME DE DUNKERQUE) * page 10, line 6 - line 21; figures 1A,1B *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5) B66C B63B
A	FR-A-1 026 104 (BANGRATZ) * page 1, left column, line 36 - right column, line 13; figures 1-3,5,6,9-11 * * page 1, right column, line 23 - line 29 *	1	
A	DE-A-2 854 157 (F. KRUPP G.M.B.H.) * figures 2F-2I *	1,5	
A	FR-A-2 570 362 (CAILLARD LEVAGE S.A.) * figures 10-16 *	1,5	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03 SEPTEMBER 1992	GUTHMULLER J.A.

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