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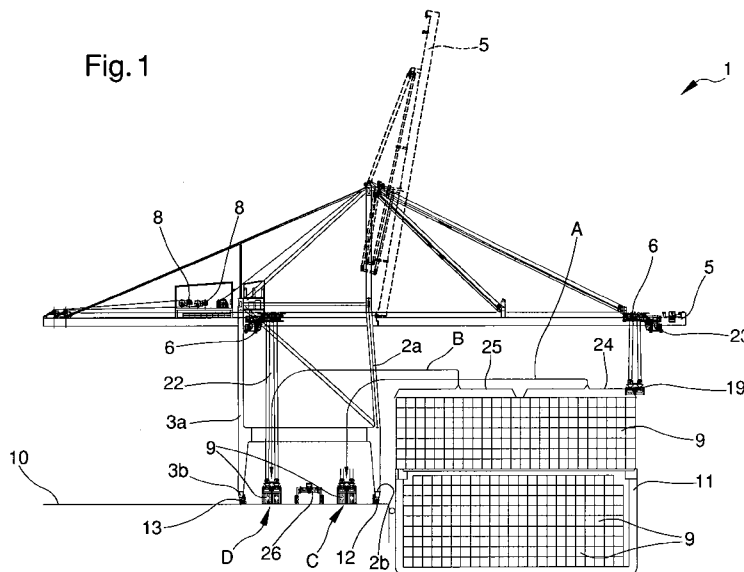
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(54) Title: DOCK CRANE FOR LIFTING AND HANDLING LOADS, IN PARTICULAR CONTAINERS

Fig. 1



(57) Abstract: Port dock crane (1) for lifting and handling loads, in particular containers (9), which comprises a first (2) and a second(3) vertical structure sliding on the ground, a scaffold frame (4) mounted substantially horizontally on the vertical structures, and a substantially horizontal jib (5) which extends overhanging from the scaffold frame, and along which at least two sliding trolleys (6) are mounted, and each one connected to respective loads lifting units (19) suitable for operate contemporarily with each other in order to lift and/or lower different loads to each other. Each trolley supports two spreaders (19), which can be connected by a spacer element (21).



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PORT DOCK CRANE FOR LIFTING AND HANDLING LOADS, IN PARTICULAR CONTAINERS

Technical Field

The present invention relates to a port dock crane for lifting and handling loads,
5 in particular containers.

Background Art

It is well known that the main activities of loading and unloading containers off and on ships take place on port docks.

These docks are equipped with large dock cranes that slide on rails
10 longitudinally and parallel to the ships.

Two handling systems or work cycles for unloading and loading a ship are known for container handling activities.

In particular, as far as the unloading or loading operations of a ship are concerned, the handling of containers starts only after the mooring of the ship
15 has been terminated.

Once moored, the dock cranes are moved into position in order to prepare for the actual loading or unloading. These cranes are positioned on the dock in front of the ship with their jibs up.

With the dock cranes side by side up to a maximum of 6, their jibs are then
20 lowered and positioned over the hold of the ship to be unloaded in order to start handling the containers.

The cranes are each equipped with their own spreaders. For some years now these so-called "twin-lift" spreader models have been utilized. These are able to handle one forty-foot container or two twenty-foot ones per cycle, and unload
25 up to 35/40 forty-foot containers or about 60/70 twenty-foot containers per hour.

Once the dock cranes have started to perform their work cycles, the port is activated for all the successive sorting and distribution activities of the containers from the inbound dock to the yard or vice versa.

30 The unloading of containers is done:

- directly by the dock crane onto trailers (either towed by a prime-mover, or tractor) for their transfer to the storage yards, where they are then placed under

yard cranes in the yard for further stacking;

or

- directly on the ground, if the port is equipped with self-loading and self-unloading equipment such as fork-lift trucks, reach-stackers or straddle carriers that can transfer the unloaded containers to the yard where they are then stacked. With this method of unloading, the dock cranes are able to increase their productivity. The reason for this is because by placing the container directly on the ground rather than having to place it on a trailer they can work more quickly and securely.

- 10 The high daily layover costs of a ship in a port, in particular for large ships also have to be taken into account.

For this reason, ports that are able to release ships in a shorter time are the ones which will be able to acquire more and more traffic and attract new shipping companies.

- 15 Therefore it is of great importance for ports to increase their productivity during all phases of the container handling, so that port operators can release ships as soon as possible.

In order to guarantee a faster turnaround time, it is necessary that the big dock cranes are able to load and unload as many containers as possible in the shortest feasible period, thus avoiding any downtime and manoeuvres that can lead to a loss of time.

Object of the Invention

The main object of the present invention is to speed up activities of loading and unloading off and on ships, starting from the system of unloading containers on the ground in order to avoid any downtime in the area under the cranes.

Other object of the present invention is to reduce containers loading and unloading time, on equal number of cranes used.

Other objet of the present invention is to allow handling a bigger number of containers compared to known cranes, on equal operating time.

- 30 The above objects are achieved by the present port dock crane for lifting and handling loads, in particular containers, which comprises at least a first and a second vertical structure sliding on the ground, at least a scaffold frame

mounted substantially horizontally on said vertical structures, and at least a substantially horizontal jib which extends overhanging from said scaffold frame, characterized in that at least two sliding trolleys along said jib are mounted, and each one connected to respective loads lifting units suitable for
5 operate contemporarily with each other in order to lift and/or lower different loads to each other.

Brief Description of the Drawings

Other characteristics and advantages of the present invention will become more evident from the description of a form of preferred, but not sole, embodiment,
10 of a port dock crane for lifting and handling loads, in particular containers, illustrated purely as an example but not limited to the annexed drawings in which:

- figure 1 is a side view of the crane according to the invention;
- figure 2 is a front view of the crane according to the invention;
- 15 figure 3 is a plan view of the crane according to the invention;
- figure 4 is a partial and front view, on an enlarged scale, of the crane wheel boxes according to the invention;
- figure 5 is a front view, on an enlarged scale, of a container hooked up and lifted by the crane according to the invention;
- 20 figure 6 is a side view of the two independent trolleys of the crane according to the invention, each trolley has two spreaders with two hooked containers;
- figure 7 is a side view of one trolley of figure 6 in an alternative operating modality, wherein there is only one spreader to handle only one container;
- figure 8 is a side and schematic view of another possible operating modality of
25 one trolley of figure 6;

Embodiments of the Invention

With particular reference to such figures, a port dock crane for lifting and handling loads, in particular containers has been globally indicated by 1.

Crane 1 comprises a first vertical bearing structure 2a, 2b and a second vertical
30 bearing structure 3a, 3b to support a scaffold frame 4a, 4b, substantially horizontal and connected to each other.

A substantially horizontal jib 5 extends overhanging from the scaffold frame 4a,

4b. Two sliding trolleys 6 along the jib 5 are mounted and provided with a pulleys series 7 which create the funicular movement of these trolleys and the relative load lifting and lowering, with respective lifting units 8 suitable for working contemporarily to lift and/or lower a plurality of containers 9 different to each other.

In detail, the first vertical structure 2a, 2b is composed of a plurality of vertical legs 2a mounted on a carrier beam 2b which connects them and which lays on an orthogonal direction respect to jib 5.

The first vertical structure 2a, 2b is positioned at the median portion of jib 5.

10 Similarly, the second vertical structure 3a, 3b is composed of two vertical legs 3a mounted on a carrier beam 3b which connects them and which lays on an orthogonal direction respect to the jib 5.

The second vertical structure 3a, 3b is approximately positioned at the median portion of the space defined between the first vertical structure 2a, 2b and one end of jib 5.

In effect, the first vertical structure 2a, 2b is located near the edge of the dock 10 for loading/unloading the containers 9 on/off the ship 11 with jib 5 which extends itself to completely cover the hold of the ship 11 in order to carry out the lifting and the placing of the containers 9 off and on said hold.

20 To the carrier beams 2b, 3b are associated two series of wheels 12, 13 sliding on respective rails (tracks) 14 and having handling means suitable for making the entire crane 1 mobile along an orthogonal direction respect to jib 5 and parallel to the edge of the dock 10.

25 These handling means aren't shown in the figures and are composed of motorized gearboxes mounted in a number to meet the necessary power requirement for handling the crane 1 on tracks 14.

The wheels 12, 13 are made of steel and are mounted in double pairs on appropriate supports or wheel boxes 15, associated to respective motorized gearboxes suitable for allowing their movement.

30 The wheel boxes 15 are anchored along the whole length of the carrier beams 2b, 3b and are associated with them through an equalizer 16 hinged on a side to the beams 2b, 3b.

There is a hydraulic cylinder 17 for each equalizer 16 that act as a hydraulic suspension, all the cylinders 17 are connected together so as to distribute the load equally and in fact create a single body piece between the wheel boxes 15 and the carrier beams 2b, 3b.

- 5 The cylinders (hydraulic jacks) 17 are connected together by a hydraulic circuit 15 that allows the transfer of the same level of oil and pressure between one cylinder and another and which hydraulic circuit is controlled by a central unit that constantly maintains the preset pressure depending on the load in any movement.
- 10 The entire scaffold frame 4a, 4b is mounted on the top of legs 2a, 3a and consists in a perimeter structure formed by cross beams 4a, which are parallel to the carrier beams 2b, 3b, and by longitudinal beams 4b, which connect the cross beams 4a and which are parallel to jib 5.

The cross beams 4a are associated with jib 5.

- 15 Jib 5 is formed by a moving front section oriented towards the sea which can be raised, and if lowered, is stretched out on the whole of the hold of the ship 11, and by a rear section oriented towards the land, which is fixed and integral with the cross beams 4a, which in turn are connected to the vertical legs 2a, 3a.

- The length of the rear section is almost equal to that of the front section of jib 5
- 20 to allow containers 9 to be unloaded also in the rear part of the crane 1 as well as from the part between the vertical bearing structures 2a, 2b and track 14 in order to distribute containers 9 rationally and efficiently in an optimized space in order to distribute them to the yard.

- The lifted configuration of front section of jib 5 is shown in figure 1 with dotted
- 25 line.

In effect, in working configuration, the front section of the jib 5 is intended to be positioned over the ship 11 once this has tied up at the dock 10.

Jib 5 has normally two sliding trolleys 6 along the same jib and a machine room which has two lifting units (lifting winches) 8, one for each trolley 6.

- 30 Each trolley 6 supports at least two spreaders 19 and since the crane 1 is equipped with two trolleys 6, there is a preferably total number of four spreaders 19 that can be handled simultaneously and independently of each

other, in order to load or unload four forty-foot containers or eight twenty-foot container.

Each trolley 6 has an equipped crosspiece 20 for holding the spreaders 19 in order to handle containers 9.

- 5 On the equipped crosspiece 20 a spacer element 21 is mounted which connect two spreaders 19, which contemporarily handle two containers 9 keeping these containers distanced to each other up to two meters (figure 8) or adjacent (figure 6) according to requirements on each case.

These equipped crosspieces 20 allow unlocking quickly both spreaders 19, 10 leaving one of them on the ground and locking, in another position, the second spreader 19, in order to work with only a spreader as shown in figure 7.

Figure 5 shows a crosspiece 20 on which top portion pulleys 7 are mounted, on which there are sliding ropes 22, which in turn are connected to lifting winches 8.

- 15 There is a control cabin 23 at the end of each trolley 6 for the operator who has to execute all the necessary operations to handling containers 9 and to handling the lifting unit 8 and, in particular, the lifting, the lowering and all handling operations of trolleys 6 and containers 9 hanged up, each one, to its spreader 19 either on loading phase or on unloading phase of containers 9 from a ship.

- 20 Control cabins 23 are mounted in the portion below the trolleys 6 and are associated to an end of them.

Handling possibilities of containers 9 can happen as shown in the configurations of the figures from 6 to 8.

- In the configuration of figure 6 is shown, for example, the solution of trolleys 6 25 with their control cabins 23 for contemporarily handling four containers 9 connected together two by two, in the configuration of figure 7 is shown one of the trolleys 6 with the lifting solution for only a container 9, whereas figure 8 shows the possibility to handle two containers 9 and to separate them by the spacer element 21.

- 30 For example, a ottimale work cycle could be: beginning from the load or unload phase of ship 11 the first trolley 6 of jib 5 will start to unload the last container 9 on the more distant side of dock 10, or rather from the last container 9 of the

row group 24 of ship 11, whereas the second trolley 6 will begin to unload from the centre of the ship 11, beginning from the row group 25, up to put all containers 9 on dock 10 in different places in order to allow handling machines 26 a simpler take, for transport them to stowage yards.

- 5 To optimize work cycles of both trolleys 6, operator of two first trolleys (front trolleys) will start first and he will take the two farthest containers 9 which will later unloaded in the nearest place on the dock 10 (covering A route of figure 1 up to C unloading zone).

Contemporarily, rear trolley will start which will take containers 9 of row group
10 25, reaching for first on dock 10 and it will unload in the farthest place from ship 11 (covering B route of figure 1 up to D unloading zone) in order to cover almost the same distance covered by the front trolley and synchronizing themselves up to the complete end of loading and unloading operations of containers 9 on the ground or on the ship 11.

- 15 Since distances to cover are essentially equals for both trolleys 6, work cycles are practically the same, up to the end of bay portions covered by jib 5 and by their four spreaders 19.

It has in point of fact been ascertained how the described invention achieves the proposed objects.

- 20 In particular, since it's simple to reach a minimum of thirty cycles per hour, productivity of crane in according to the invention will be able to reach over 120 forty-foot containers (or 240 twenty-foot containers) unloaded or loaded per hour, against the 50/60 forty-foot containers (or 100/120 twenty-foot containers) unloaded or loaded today by most evolved cranes, having two
25 "twin-lift" spreaders.

Crane, according to the invention, has the peculiarity to have a control cabin for each bringing spreader trolley which allows every operator to operate and control all the operations in a simply and securely way.

- Another peculiarity of the invention is given by wheel boxes which are mounted
30 on a hydraulic suspensions unit which allow lowering and distributing weight equally either on the wheels or on the rails and, also, on the deck.

The invention thus conceived is susceptible to numerous modifications and

variations, all of which falling within the scope of the inventive concept.

Furthermore all the details can be replaced with others that are technically equivalent.

In practice, the materials used, as well as the contingent shapes and dimensions,
5 may be any according to requirements without because of this moving outside
the protection scope of the following claims.

CLAIMS

- 1) Port dock crane for lifting and handling loads, in particular containers, which comprises at least a first and a second vertical structure sliding on the ground, at least a scaffold frame mounted substantially horizontally on said vertical structures, and at least a substantially horizontal jib which extends overhanging from said scaffold frame, characterized in that at least two sliding trolleys along said jib are mounted, and each one connected to respective loads lifting units suitable for operate contemporarily with each other in order to lift and/or lower different loads to each other.
- 5 2) Crane according to claim 1, characterized in that said trolleys are independent to each other.
- 3) Crane according to one or more of the preceding claims, characterized in that said lifting units are independent to each other.
- 4) Crane according to one or more of the preceding claims, characterized in that at least one of said trolleys comprises at least a spreader for holding said load.
- 15 5) Crane according to one or more of the preceding claims, characterized in that at least one of said trolley comprises two said spreaders.
- 6) Crane according to one or more of the preceding claims, characterized in that at least one of said trolleys comprises at least a spacer element for connecting said spreaders.
- 20 7) Crane according to one or more of the preceding claims, characterized in that said spacer element can be extended between a first configuration, wherein connected loads are approached to each other, and a second configuration, wherein connected loads are spaced to each other.
- 25 8) Crane according to one or more of the preceding claims, characterized in that at least one of said trolleys comprises at least a control cabin.
- 9) Crane according to claim 8 characterized in that said control cabin is displaced on an end of said trolleys.
- 30 10) Crane according to one or more of the preceding claims, characterized in that at least one of said vertical structures has a plurality of substantially vertical legs mounted on a carrier beam extended substantially horizontally along a

direction substantially transversely respect to said jib.

11) Crane according to one or more of the preceding claims, characterized in that it comprises handling means of said vertical structures along a direction substantially transversally respect to said jib.

5 12) Crane according to one or more of the preceding claims, characterized in that it comprises a plurality of wheels associated along said carrier beam.

13) Crane according to one or more of the preceding claims, characterized in that said wheels are sliding on rails.

14) Crane according to one or more of the preceding claims, characterized in
10 that said wheels are mounted in double pairs on wheel boxes.

15) Crane according to one or more of the preceding claims, characterized in that said wheel boxes are associated along the whole length of said carrier beams.

16) Crane according to one or more of the preceding claims, characterized in
15 that at least one of said wheel boxes is associated with said vertical structures through at least an equalizer.

17) Crane according to one or more of the preceding claims, characterized in that said equalizer has an end hinged to said carrier beams and the opposite end associated with said carrier beams by a hydraulic cylinder.

20 18) Crane according to one or more of the preceding claims, characterized in that said hydraulic cylinders are connected to each other by at least a hydraulic circuit.

19) Crane according to one or more of the preceding claims, characterized in that said hydraulic circuit is controlled by a control unit in order to regulate the
25 hydraulic pressure in said hydraulic cylinders suitable for distribute equally the weight of the whole structure onto said wheels.

20) Crane according to one or more of the preceding claims, characterized in that on said jib, two trolleys connected to two respective lifting units are mounted, each one of said lifting units being connected to two spreaders by an
30 equipped crosspiece.

Fig. 2

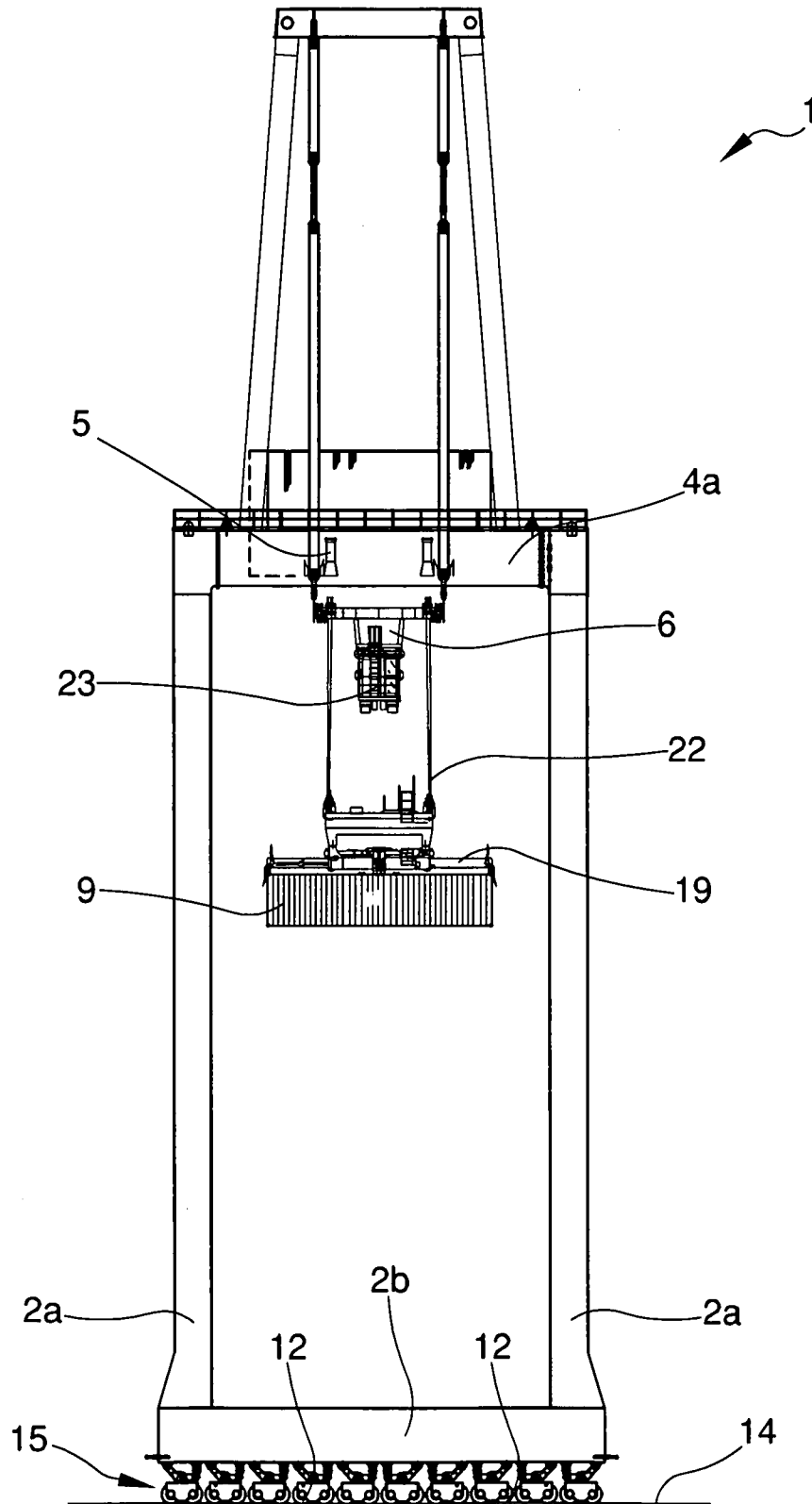


Fig. 3

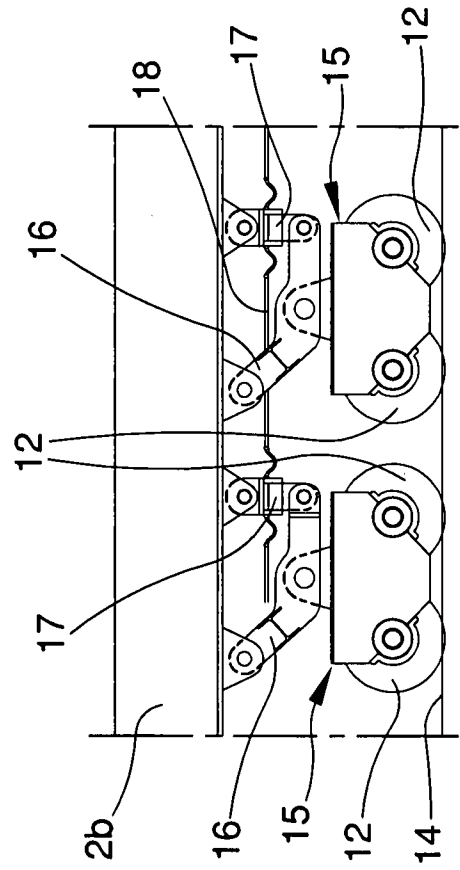
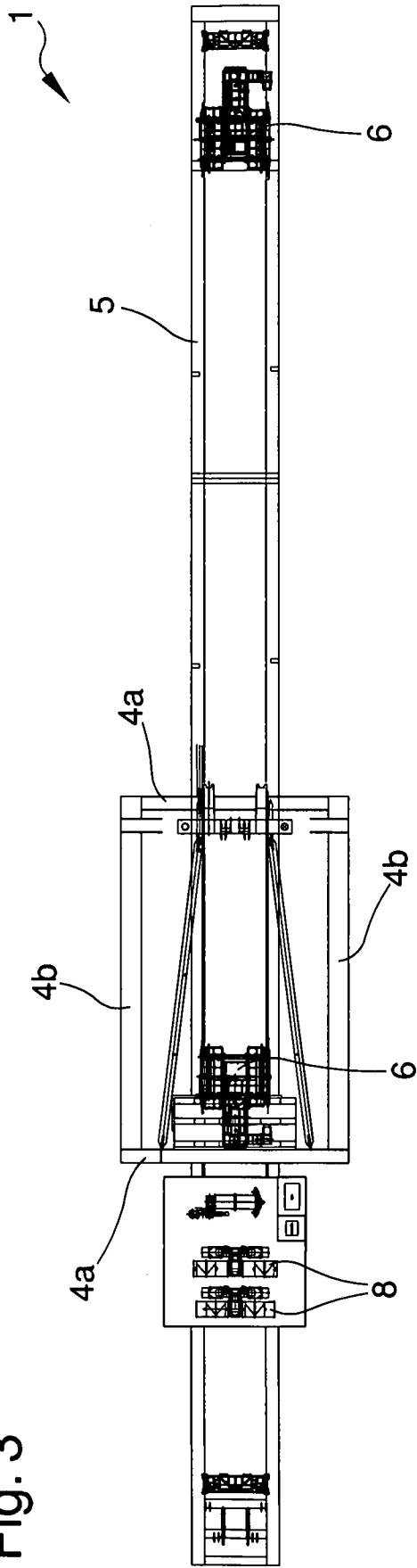


Fig. 4

Fig. 5

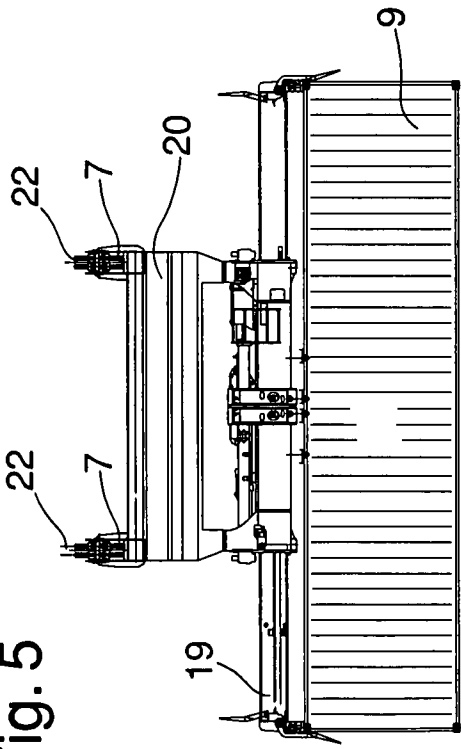


Fig. 7

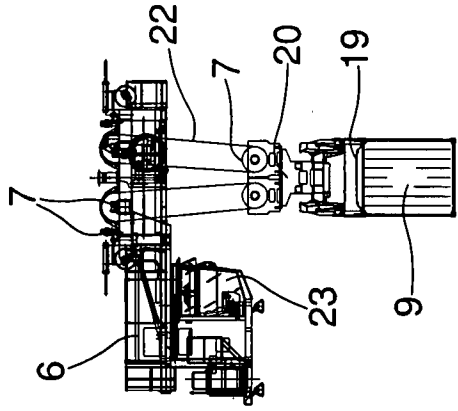


Fig. 8

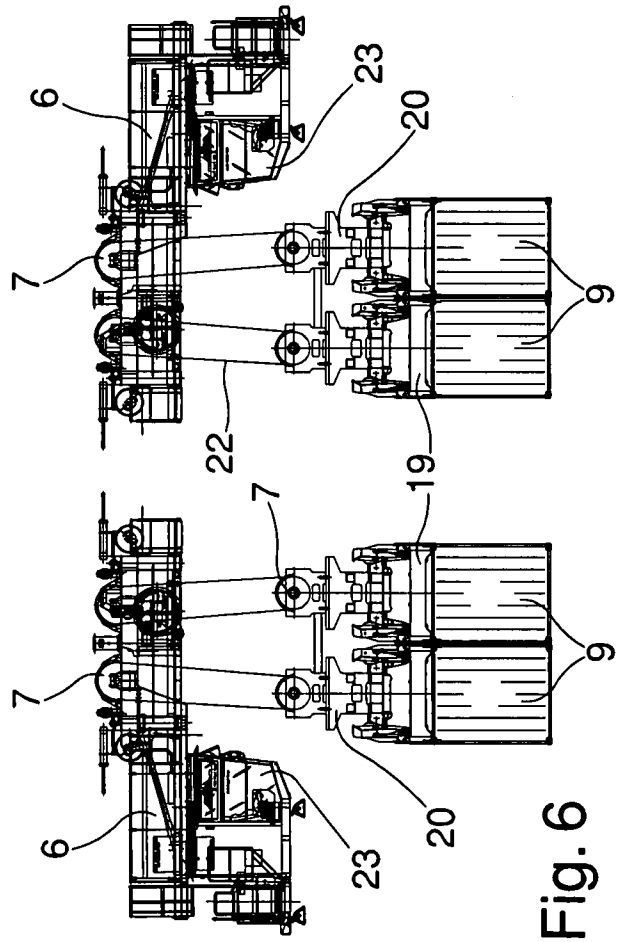
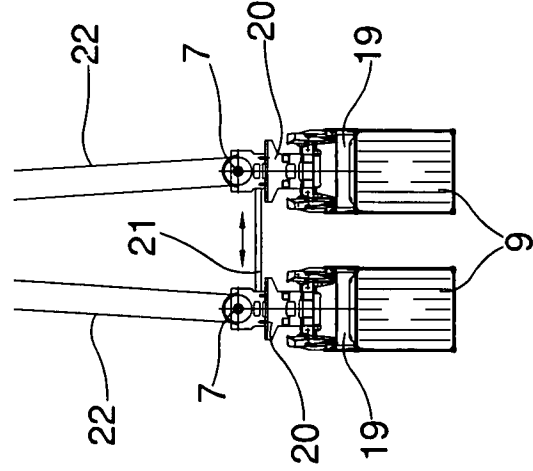


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2009/005098

A. CLASSIFICATION OF SUBJECT MATTER INV. B66C1/10 B66C9/12 B66C19/00				
According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED				
Minimum documentation searched (classification system followed by classification symbols) B66C				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X Y X Y Y	DE 197 03 286 A1 (GARCIA ESTEBANEZ EVA [DE]) 6 August 1998 (1998-08-06) the whole document ----- DE 199 09 466 A1 (MANNESMANN REXROTH AG [DE]) 7 October 1999 (1999-10-07) abstract column 5, line 50 - column 6, line 17 figures ----- EP 1 650 156 A (SHANGHAI ZHENHUA PORT MACH CO [CN]) 26 April 2006 (2006-04-26) abstract figures 1,2 ----- -/--	1-4,8-11 5-7,20 1-3, 10-15 16 5-7,20		
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. </td> <td style="width: 50%; border: none;"> <input checked="" type="checkbox"/> See patent family annex. </td> </tr> </table>			<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.
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A document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *&* document member of the same patent family			
Date of the actual completion of the international search <p style="text-align: center; font-weight: bold;">4 August 2009</p>	Date of mailing of the international search report <p style="text-align: center; font-weight: bold;">12/08/2009</p>			
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040. Fax: (+31-70) 340-3016	Authorized officer <p style="text-align: center; font-weight: bold;">Sheppard, Bruce</p>			

INTERNATIONAL SEARCH REPORT

International application No
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Information on patent family members

International application No PCT/IB2009/005098

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