

(19)



Europäisches Patentamt

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Office européen des brevets



(11)

EP 0 952 955 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

11.12.2002 Bulletin 2002/50

(21) Application number: **98900567.3**

(22) Date of filing: **12.01.1998**

(51) Int Cl.7: **B66C 11/00**, B66C 19/00

(86) International application number:
PCT/GB98/00071

(87) International publication number:
WO 98/030485 (16.07.1998 Gazette 1998/28)

(54) **CRANE**

KRAN

GRUE

(84) Designated Contracting States:
BE DE GB NL

(30) Priority: **14.01.1997 GB 9700637**

(43) Date of publication of application:
03.11.1999 Bulletin 1999/44

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Description

[0001] This invention relates to a crane, particularly though not exclusively a crane that is suitable for use in loading or unloading a vehicle, a conveyor belt or a vessel such as a ship. The invention also encompasses a method of operating such a crane.

[0002] The invention will be explained hereinafter in relation to loading and unloading of cargo ships, it being understood, however, that the invention can be applied to the movement of goods or commodities in any circumstances or within any facility, for example in loading or unloading other cargo-carrying means such as land vehicles or conveyor belts.

[0003] Cargo ships form the backbone of worldwide trade, carrying cargo ranging from loose bulk materials to freight containers all over the globe. This cargo can be carried internally within holds that are typically covered by movable hatches, or externally on deck as is common on container ships.

[0004] Economics dictate that a cargo ship must be unloaded and then reloaded as quickly as possible when it is in port. At present, these operations are commonly performed by an array of gantry cranes at dockside, each crane of the array being aligned with a respective hatch of the ship to gain access to the holds or being aligned with, for example, particular containers on deck. The cranes can be moved along the dockside with respect to the ship for this purpose.

[0005] Each crane typically includes a lifting tackle suspended by wires from a trolley. The trolley is movable on an elevated horizontal track defined by a pair of rails supported by a jib or gantry, the trolley spanning the gap between the rails. The trolley reciprocates between two positions during an unloading operation, one position being for lifting items from the ship and the other position being for depositing those items at dockside. The items may, for example, be deposited onto a vehicle such as a truck or a train, or possibly onto a conveyor belt that carries the items away as they are deposited thereon. Of course, a loading operation is merely the same operation in reverse.

[0006] An array of several cranes all operating simultaneously or in parallel allows faster handling of cargo than if a single crane is used successively to access different positions along the ship. However, there is a speed limit determined by the time that each trolley takes to move between the two abovementioned positions. Accordingly, for a substantial part of the operation, the jib of the crane lies uselessly over the ship waiting for the trolley to return before further items can be lifted out or lowered on board.

[0007] Attempts to speed the process by providing more than one crane for each hold or position along the ship's length are impractical. Each crane is necessarily bulky if it is to support substantial loads; this means that there is too little room for two such bulky cranes to fit side-by-side without mutual interference while still being

correctly aligned with respect to the ship and its cargo.

[0008] Applicant has had the insight that the speed limit on the loading or unloading process could be raised enormously if a single crane could have two or more lifting tackles operating simultaneously and preferably independently of one another. This would have the same effect as if two or more cranes were working in the same location, and could be expected to multiply the speed of the process in accordance with the number of tackles used.

[0009] In order to operate two or more tackles along the same gantry in order to emulate two or more cranes working in the same location, it is essential that the tackles and their loads or lifts should be able to pass clear of each other at all times. Of course, the structure of the crane itself must also be capable of working safely with the combined weights, momentum and vibrations involved in simultaneous multiple lifts.

[0010] Applicant has found old prior art disclosures of cranes in different technical fields that employ more than one tackle but these multiple tackles act on one load and do not teach accelerating a loading or unloading process involving multiple discrete loads. Accordingly, they do not lead to the present invention which involves simultaneous movement of discrete loads to speed the process of transfer.

[0011] For example, UK Patent No. 1,223,379 to Krupp was published in 1971. It discloses an overhead travelling crane for use in the shipbuilding industry, particularly for moving single large pre-constructed sections of a ship which may weigh several hundred tons. The crane is on a massive scale: it is in the form of a bridge supported by columns, one at each end, which travel on rails on opposite sides of a dry dock in which a ship is to be built.

[0012] Krupp's crane provides for turning a single heavy load about either a horizontal or vertical axis, as may for example be necessary to turn a prefabricated ship section through 90° from its orientation on delivery at the shipyard to the orientation required for installation on a ship being built. This is achieved by running two crabs on each side of the bridge, thus making four crabs in total, with the crabs being divided into an upper pair, one upper crab being situated on each side of the bridge, and a lower pair, one lower crab being situated on each side of the bridge. Cables hang from each crab to support the load.

[0013] Various means are provided whereby the upper pair and the lower pair of crabs can pass each other without the crabs, their cables, their tackles or suspended loads fouling each other. This relative movement between the pairs of crabs causes the load to turn as desired, in conjunction with varying the lengths of the cables and optionally removing and reattaching the cables at different points on the load during the turning process.

[0014] Whilst the individual crabs and the pairs of crabs are independently movable, their movements are, in a sense, always linked to each other. This is because

the crabs always support one and the same load and must therefore move in a continuously coordinated manner within a range of movement limited by the overall size of the load.

[0015] Moreover, the Krupp crane is designed for painstaking and careful orientation of single, very large loads, in which it is acceptable to remove and reattach cables as the crabs pass each other. The present invention requires no such steps. In general, there is no teaching in Krupp of crab movement suitable for the large, rapid, repetitive and preferably independent movements that are used when loading or unloading a ship. It is also noted that the Krupp crane would not be suitable for dockside use, even if scaled down, because it requires support at both ends of the bridge.

[0016] UK Patent Nos. 907,399 and 972,477, both to Creusot, are a decade older than Krupp. They describe cranes for suspending and tilting a movable ladle in a steelworks. The cranes employ an arrangement of three tackles, two mounted on an upper trolley that support the weight of the ladle and one mounted on a lower trolley that controls the tilt of the ladle. The trolleys run along respective tracks, the lower trolley running on a track that is narrower than and lies beneath the other track. In this way, during a tilting operation, the inner trolley and its tackle can run inside the tackles suspended from the outer trolley without interfering with the outer trolley or its tackles.

[0017] As with Krupp, the Creusot documents are concerned with positioning and orienting a single load, which must be moved slowly and precisely. The movements of the various tackles and the range of that movement are therefore constrained. It is also noted that the Creusot cranes would not be suitable for dockside use, even in the unlikely event that a person seeking to load or unload a ship would look to the art of steelmaking for a solution.

[0018] In summary, therefore, neither Krupp nor Creusot move separate loads quickly and efficiently using a single crane having more than one tackle.

[0019] FR-A-2196288 to Conrad-Stork B.V. discloses a method of operating a crane, the method comprising moving goods or commodities in a plurality of loads, wherein: each load is carried by a respective carriage that moves reciprocally with respect to the crane along a respective path to transfer the load and return for a further load; the carriages pass each other as they reciprocate along their respective paths; and at least one carriage changes configuration to avoid collision with another carriage or its load as the carriages pass each other.

[0020] FR-A-2196288 also discloses a crane adapted to move goods or commodities in a plurality of loads, the crane comprising a plurality of carriages each moveable reciprocally with respect to the crane along a respective path to transfer a load and return for a further load, the carriages passing each other as they reciprocate along their respective paths; and means for changing the con-

figuration of at least one carriage to avoid collision with another carriage or its load as the carriages pass each other.

[0021] From both aspects, the present invention is characterised in that the change of configuration to avoid collision involves one carriage passing within another carriage.

[0022] Preferably, the method of the invention is applied to loading and/or unloading a cargo carrying means such as a ship and so comprises moving cargo in a plurality of loads.

[0023] The invention also resides in optional features defined in the sub-claims.

[0024] In order that the invention can be more readily understood, reference will now be made, by way of example only, to the accompanying drawings in which:

Figure 1 is a simplified perspective view of a gantry crane having two tackles passing clear of each other in a nested arrangement;

Figure 2 is a cross-sectional end view of the gantry crane of Figure 1, the crane having tracks disposed in a tiered arrangement, where trolleys span the width of the tracks;

Figure 3 is a side elevation of the gantry crane of Figure 1, showing a collision prevention zone;

Figure 4 is a plan view from underneath of the crane of Figures 1, 2 and 3;

Figure 5 is a cross-sectional end view of a gantry crane having an inner track, a trolley spanning the width of the inner track, and an outer track comprising two parallel rails, each rail carrying a separate half-trolley or crab; and

Figure 6 is a cross-sectional end view of a gantry crane as in Figures 1 to 4, but showing a wire arrangement adapted to suit unitised lifts such as containers.

[0025] Referring to Figures 1 to 4, a gantry crane 14 comprises an elevated elongate jib or gantry 15 that extends horizontally in cantilevered fashion from a support offset towards one end. The support comprises two pairs of legs 16, the legs of each pair splaying apart towards the ground for stability. The gantry 15 is a framework box section of tubular steel elements for strength and lightness.

[0026] As best shown in Figure 2, the gantry supports an upper pair of rails 17 and a lower pair of rails 18 that respectively define upper and lower tracks in tiered relation. Each track supports and is spanned by a respective trolley, the upper track having a relatively wide upper trolley 19 thereon and the lower track having a relatively narrower lower trolley 20 thereon. Each trolley 19, 20

supports a respective pair of wires 21 which converge downwardly from sheaves 22 to tackles 23 and 24 respectively.

[0027] The tracks and trolleys 19, 20 are so arranged that the lower track and trolley 20 can pass within the wires 21 that depend from the upper trolley 19, in a nested relationship. As shown in Figures 1 and 3, it is also necessary for the tackle 23 to be lifted above tackle 24 to an extent that permits any load hanging from tackle 23 to clear tackle 24 and its associated wires. However, there is no need to remove a load from either tackle 23, 24 as the trolleys 19, 20 pass each other.

[0028] Safety is, of course, paramount in any crane system. The primary safety issue to be considered in practice of the present invention is the risk of a collision between loads, tackles and wires as the tackles move in relation to one another. This can be avoided by electromechanical sensors and cut-outs, microprocessor controlled brakes or other logical switching to the same effect.

[0029] With reference to Figure 3, these safety measures can be used to create a 'collision prevention zone' shown in dashed lines to ensure that the tackle 23 and any load supported thereby are progressively lifted by the lower trolley 20 as they reach a minimum separation on approaching tackle 24, so that the tackle 23 is at all times high enough to avoid collision; and if this is not so, the abovementioned safety measures should correct the situation or stop movement of whichever trolley 19, 20 is moving.

[0030] Figure 4 shows the trolleys 19, 20 passing each other and also shows how the box structure of the gantry 15 itself can define the rails 17, 18. In this arrangement, the rails 17, 18 are four parallel longitudinal members connected at their ends by transverse members 25. The legs 16 are attached to the upper rails 17 which are also the outer rails as seen in Figure 4.

[0031] In this arrangement, the vertical spacing between the upper rails 17 and lower rails 18 increases the beam stiffness of the structure as a whole. This particularly lends the invention to the construction of cantilevered cranes suitable for use in docks for loading and unloading ships. However, this increased stiffness will obviously be of benefit to all cranes, including bridge cranes.

[0032] Whilst the embodiment of Figures 1 to 4 permits the use of trolleys of conventional design, it will be apparent that the lower pair of rails 18 defining the lower track can only be supported beyond the desired extremes of movement of the upper trolley 19. This is because any supports placed along the length of the lower track will either interfere with the movement of the upper trolley 19 if they extend generally vertically, or with the movement of the tackle 24 and wires 21 of the upper trolley 19 if they extend generally horizontally. Accordingly, although this embodiment is attractive due to its simplicity, in practice its use could be limited to lighter cargo due to the bending loads on the lower track.

[0033] Referring now to Figure 5, an alternative embodiment of the invention employs an inner trolley 26 running on an inner pair of rails 27 that define an inner track akin to the lower track of Figures 2 and 3. A pair of crabs 28 - effectively two halves of an outer trolley - run outside the rails 27 on an outer pair of rails 29. Otherwise, the arrangement is nested substantially as in Figures 1 to 4, and like numerals refer to like parts.

[0034] It will be noted that eliminating the upper trolley of Figures 2 and 3 enables the inner pair of rails 27 to be supported from above by a gantry at any or all points along their length - for example by suspending the rails by vertical struts depending from a gantry frame above (not shown) - without interfering with the movement of the crabs 28.

[0035] It is preferred that the pairs of crabs move in rigid conformity with each other. This could be achieved, for example, by the use of synchronous electric drive motors controlled by microprocessors. It would also be possible for one crab 28 to convey positional information to the other crab 28, for example by transmitting infrared signals to the other crab 28 which can be interpreted and used to synchronise the movement of the other crab 28. Other electromechanical devices could be used to achieve the same effect.

[0036] Turning finally to Figure 6, a further embodiment of the invention corresponds broadly to the tiered and nested embodiment of Figures 1 to 4 and again like numerals are used for like parts. This embodiment is adapted for use with unitised items of standard dimensions such as containers of 12.19 metres (40 feet) in length. In that application, the tackle commonly has to be lowered into spaces between neighbouring stacked containers on into cellguides in the hold, only as wide as a container itself. In this case it is necessary to provide a reducing means for the wires to the tackles so as to fit the space restrictions, for example by using wire spreaders and collectors as part of the tackle of the outer/upper trolley.

[0037] One such example is the container ship loading and discharge shown in Figure 6. In this case the loads or lifts are standard containers. Accordingly, the narrower inner/lower trolley 30 and its tackle 31 are limited to 12.19 metres (40 feet) as their maximum transverse dimension.

[0038] Of course, the upper/outer trolley 32 needs to be wider than 12.19 metres (40 feet) if its wires are to clear the lower/inner trolley 30; but the tackle 33 of the upper/outer trolley 32 has to be brought down to a maximum width of 12.19 metres (40 feet) if it is to reach between the neighbouring containers 34 and lock onto another container 35. To achieve this, a wire collector frame 36 is suspended by wires 37 below the point where the narrower lower/inner trolley 30 will clear its lift through the wider tackle 33.

[0039] Many variations are possible without departing from the inventive concept.

[0040] For example, the half-trolley or crab arrange-

ment of Figure 5 could be applied to the embodiment of Figure 6 that is adapted to handle unitised loads.

[0041] The aforementioned safety measures can be made more active by providing for automatic control of the path taken by the tackles and hence by any loads that they support. This motion could be pre-programmed according to a memorised and possibly standardised pattern of movements appropriate to the loads in question, and/or could be controlled by sensors that monitor the clearance between passing tackles, wires and loads and so enable a microprocessor to determine a safe path.

[0042] The cranes of the invention can also be driven manually, in which case a driver's cab could be attached to or otherwise associated with each respective trolley or crab so as to follow the movement of the respective tackle. If clearances are critical, as may be the case with unitised lifts for example, the cabs could be separate from the trolleys or crabs and could run on further tracks that are independent of the tracks on which the trolleys move. In this case, it would be advantageous to synchronise the movement of a cab to the trolley that the cab commands. The means for synchronising cab movement could, for example, be as set out above in relation to the embodiment of Figure 5 for synchronising the movement of the crabs 28.

[0043] Whilst the abovementioned embodiments all involve two tackles, one nested within the other, it would be possible and desirable to have three or more tackles operating in a nested arrangement if space permits.

[0044] It would of course be possible to have all trolleys, including the innermost one, defined by two crabs or half trolleys. Also, whilst the embodiment of Figure 5 is shown with the inner and outer pairs of rails substantially level, the pairs of rails could be disposed at different levels with one above the other in a tiered structure.

Claims

1. A method of operating a crane (14), the method comprising moving goods or commodities in a plurality of loads, wherein: each load is carried by a respective carriage that moves reciprocally with respect to the crane (14) along a respective path to transfer the load and return for a further load; the carriages pass each other as they reciprocate along their respective paths; and at least one carriage changes configuration to avoid collision with another carriage or its load as the carriages pass each other, **characterised in that** the change of configuration to avoid collision involves one carriage passing within another carriage.
2. The method of claim 1, wherein each carriage comprises a travelling hoist, suspension means for suspending a load from the hoist and load engagement means for engaging a load.
3. The method of claim 2, wherein the load engagement means is a tackle (23, 24), a grab or means for engaging a container.
4. The method of claim 2, wherein the suspension means varies in length to change the configuration of a carriage.
5. The method of claim 4, wherein a carriage changes configuration during collision avoidance by the suspension means raising or lowering the load engagement means.
6. The method of claim 5, wherein the suspension means comprises first and second strands one on each side of the load engagement means and both strands are lengthened or shortened together to raise or lower the load.
7. The method of claim 4, wherein the carriage changes configuration during collision avoidance when the suspension means moves the load engagement means transversely with respect to the general direction of travel of the carriage.
8. The method of any preceding claim, wherein the carriages move independently of one another.
9. The method of any preceding claim, wherein the carriages reciprocate over a range of movement that is substantially larger than the loads being carried.
10. The method of any preceding claim, wherein configuration of the carriages for collision avoidance is under automatic control and configuration follows a stored predetermined pattern as the carriages reciprocate.
11. The method of any preceding claim, wherein controlling the configuration of the carriages for collision avoidance includes automatically monitoring the clearance between passing carriages including any loads that they carry.
12. The method of any preceding claim, wherein the loads are carried by their respective carriages throughout the range of movement of the carriages.
13. A crane (14) adapted to move goods or commodities in a plurality of loads, the crane (14) comprising a plurality of carriages each movable reciprocally with respect to the crane (14) along a respective path to transfer a load and return for a further load, the carriages passing each other as they reciprocate along their respective paths; and means for changing the configuration of at least one carriage to avoid collision with another carriage or its load as

the carriages pass each other, **characterised in that** the change of configuration to avoid collision involves one carriage passing within another carriage.

14. The crane (14) of claim 13, wherein each carriage comprises a travelling hoist, suspension means for suspending a load from the hoist and load engagement means for engaging a load.
15. The crane (14) of claim 14, including means for varying the length of the suspension means to change the configuration of a carriage.
16. The crane (14) of claim 15, wherein the suspension means comprises first and second strands one on each side of the load engagement means.
17. The crane (14) of claim 16, comprising means for varying the length of the first and second strands in unison with one another.
18. The crane (14) of claim 16, comprising means for varying the relative lengths of the first and second strands.
19. The crane (14) of any of claims 13 to 18, wherein the load engagement means is a tackle (23, 24), a grab or means for engaging a container.
20. The crane (14) of any of claims 13 to 19, wherein the carriages are movable along respective tracks that are in nested relation.
21. The crane (14) of claim 20, wherein the carriages are movable along respective tracks that are in tiered relation.
22. The crane (14) of any of claims 13 to 21, comprising collision avoidance means under automatic control associated with storage means for storing a predetermined pattern of carriage configuration.
23. The crane (14) of any of claims 13 to 22, comprising automatic monitoring means for monitoring the clearance between passing carriages including any loads that they carry.
24. The crane (14) of any of claims 13 to 23, comprising collision prevention means adapted to ensure that the configuration of a carriage is changed to avoid collision as that carriage reaches a minimum separation from another approaching carriage.
25. The crane (14) of any of claims 13 to 24, comprising an elevated elongate jib or gantry (15) that extends horizontally in cantilevered fashion from an upright support offset towards one end.

26. The crane (14) of claim 25, wherein the jib or gantry (15) is a framework of structural elements including upper (17) and lower (18) rails, the rails defining upper and lower tracks disposed in tiered relation and a carriage being movable along each respective track.
27. The crane (14) of claim 25 or claim 26, wherein the rails are parallel longitudinal members connected at their ends by transverse members (25).
28. The crane (14) of any of claims 25 to 27, wherein the support is attached to rails that are disposed outermost.
29. The crane (14) of any of claims 13 to 28, wherein tracks support and are each spanned by a respective travelling hoist, an upper track having a relatively wide upper trolley (19) thereon and a lower track having a relatively narrow lower trolley (20) thereon.
30. The crane (14) of claim 29, wherein the lower track and lower hoist pass within suspension means that depend from the upper hoist.
31. The crane (14) of any of claims 13 to 30, comprising a pair of crabs (28) running on a pair of outer rails disposed outside and one each side of an inner track, each crab (28) running on a respective outer rail.
32. The crane (14) of claim 31, comprising means for moving the crabs (28) in conformity with each other.
33. The crane (14) of claim 31 or claim 32, wherein the inner track includes at least one rail supported from above at any or all points along its functional length.
34. The crane (14) of any of claims 13 to 33, adapted for use with unitised items of standard dimensions.
35. The crane (14) of claim 34, wherein the unitised items are standard containers.
36. The crane (14) of claim 35, wherein load engaging means is capable of being lowered into a space between neighbouring stacked containers or cellguides that is substantially as wide as a container itself.
37. The crane (14) of claim 36, wherein a reducing means operates on suspension means that suspends the load engaging means.
38. The crane (14) of any of claims 13 to 37, comprising a driver's cab attached to or otherwise associated with each respective carriage so as to follow the

movement of that carriage.

39. The crane (14) of claim 38, wherein the cabs are separate from the carriages and run on dedicated tracks.
40. The crane (14) of claim 39, comprising means to synchronise the movement of a cab to the movement of a carriage that the cab commands.
41. The crane (14) of any of claims 13 to 40, comprising three or more tackles operating in a nested arrangement.

Patentansprüche

1. Verfahren des Betriebes eines Kranes (14), wobei das Verfahren das Bewegen von Gütern bzw. Waren in einer Vielzahl von Lasten umfasst, in welchem: jede Last von einem jeweiligen Wagen befördert wird, der sich hin und her bezüglich des Kranes (14) entlang einer jeweiligen Bahn bewegt, um die Last weiterzugeben und für eine weitere Last zurückzukehren; die Wagen aneinander vorbeilaufen, wenn sie sich entlang ihrer jeweiligen Bahnen hin- und herbewegen; und mindestens ein Wagen die Anordnung ändert, um die Kollision mit dem anderen Wagen bzw. seiner Last zu vermeiden, wenn die Wagen aneinander vorbeilaufen, **dadurch gekennzeichnet, dass** die Änderung der Anordnung, um die Kollision zu vermeiden, einen Wagen einschließt, der innerhalb des anderen Wagens vorbeiläuft.
2. Verfahren nach Anspruch 1, in welchem jeder Wagen eine Fahrwinde, Aufhängevorrichtungen für das Aufhängen einer Last von der Winde und Lasteingriffsvorrichtungen für das Eingreifen einer Last umfasst.
3. Verfahren nach Anspruch 2, in welchem die Lasteingriffsvorrichtungen ein Hebezeug (23, 24), ein Greifer bzw. Vorrichtungen für das Eingreifen eines Containers sind.
4. Verfahren nach Anspruch 2, in welchem sich die Aufhängevorrichtungen in der Länge ändern, um die Anordnung eines Wagens zu verändern.
5. Verfahren nach Anspruch 4, in welchem sich die Anordnung eines Wagens während der Kollisionsvermeidung durch die Aufhängevorrichtungen durch Heben bzw. Senken der Lasteingriffsvorrichtungen ändert.
6. Verfahren nach Anspruch 5, in welchem die Aufhängevorrichtungen einen ersten und einen zweiten

Strang umfassen, einen auf jeder Seite der Lasteingriffsvorrichtungen, und beide Stränge zusammen verlängert bzw. verkürzt werden, um die Last zu heben bzw. zu senken.

7. Verfahren nach Anspruch 4, in welchem der Wagen die Anordnung während der Kollisionsvermeidung ändert, wenn die Aufhängevorrichtungen die Lasteingriffsvorrichtungen quer bezüglich der üblichen Fahrtrichtung des Wagens bewegen.
8. Verfahren nach jedem vorangegangenen Anspruch, in welchem sich die Wagen unabhängig voneinander bewegen.
9. Verfahren nach jedem vorangegangenen Anspruch, in welchem sich die Wagen in einem Bewegungsbereich hin- und herbewegen, der im Wesentlichen größer als die Lasten ist, die befördert werden.
10. Verfahren nach jedem vorangegangenen Anspruch, in welchem die Anordnung der Wagen zur Kollisionsvermeidung unter automatischer Steuerung ist, und die Anordnung einem gespeicherten vordefinierten Muster folgt, wenn sich die Wagen hin- und herbewegen.
11. Verfahren nach jedem vorangegangenen Anspruch, in welchem die Steuerung der Anordnung der Wagen zur Kollisionsvermeidung automatisch die Überwachung des Zwischenraumes zwischen den vorbeilaufenden Wagen umfasst, einschließlich aller Lasten, die sie befördern.
12. Verfahren nach jedem vorangegangenen Anspruch, in welchem die Lasten von ihren jeweiligen Wagen durch den ganzen Bewegungsbereich der Wagen befördert werden.
13. Kran (14), der geeignet ist, um Güter bzw. Waren in einer Vielzahl von Lasten zu transportieren, wobei der Kran (14) umfasst eine Vielzahl von Wagen, von denen jeder hin und her bezüglich des Kranes (14) entlang einer jeweiligen Bahn bewegbar ist, um eine Last weiterzugeben und für eine weitere Last zurückzukehren, wobei die Wagen aneinander vorbeilaufen, wenn sie sich entlang ihrer jeweiligen Bahnen hin- und herbewegen; und Vorrichtungen zur Änderung der Anordnung von mindestens einem Wagen, um die Kollision mit dem anderen Wagen bzw. seiner Last zu vermeiden, wenn die Wagen aneinander vorbeilaufen, **dadurch gekennzeichnet, dass** die Änderung der Anordnung, um die Kollision zu vermeiden, einen Wagen einschließt, der innerhalb des anderen Wagens vorbeiläuft.

14. Kran (14) nach Anspruch 13, in welchem jeder Wagen eine Fahrwinde, Aufhängevorrichtungen für das Aufhängen einer Last von der Winde und Lasteingriffsvorrichtungen für das Eingreifen einer Last umfasst. 5
15. Kran (14) nach Anspruch 14, der Vorrichtungen zur Änderung der Länge der Aufhängevorrichtungen einschließt, um die Anordnung eines Wagens zu ändern. 10
16. Kran (14) nach Anspruch 15, in welchem die Aufhängevorrichtungen einen ersten und einen zweiten Strang umfassen, einen auf jeder Seite der Lasteingriffsvorrichtungen. 15
17. Kran (14) nach Anspruch 16, der Vorrichtungen zur Änderung der Länge des ersten und des zweiten Stranges übereinstimmend mit einem anderen umfasst. 20
18. Kran (14) nach Anspruch 16, der Vorrichtungen zur Änderung der relativen Längen des ersten und des zweiten Stranges umfasst. 25
19. Kran (14) nach jedem der Ansprüche 13 bis 18, in welchem die Lasteingriffsvorrichtungen ein Hebezeug (23, 24), ein Greifer bzw. Vorrichtungen für das Eingreifen eines Containers sind. 30
20. Kran (14) nach jedem der Ansprüche 13 bis 19, in welchem die Wagen entlang der jeweiligen Bahnen bewegbar sind, die in verschachtelter Beziehung sind. 35
21. Kran (14) nach Anspruch 20, in welchem die Wagen entlang der jeweiligen Bahnen bewegbar sind, die in etagenförmiger Beziehung sind. 40
22. Kran (14) nach jedem der Ansprüche 13 bis 21, der Vorrichtungen zur Kollisionsvermeidung unter automatischer Steuerung umfasst, die mit Speichervorrichtungen zur Speicherung eines vordefinierten Musters der Wagenanordnung verbunden sind. 45
23. Kran (14) nach jedem der Ansprüche 13 bis 22, der automatische Überwachungsvorrichtungen zur Überwachung des Zwischenraumes zwischen den vorbeilaufenden Wagen umfasst, einschließlich aller Lasten, die sie befördern. 50
24. Kran (14) nach jedem der Ansprüche 13 bis 23, der Kollisionsverhütungsvorrichtungen umfasst, die geeignet sind, um sicherzustellen, dass die Anordnung eines Wagens geändert wird, um die Kollision zu vermeiden, wenn dieser Wagen einen Mindestabstand von dem anderen herannahenden Wagen erreicht. 55
25. Kran (14) nach jedem der Ansprüche 13 bis 24, der einen obenliegenden verlängerten Ausleger bzw. Portal (15) umfasst, das sich horizontal in freitragender Form von einem Stützgerüst erstreckt, das zu einem Ende hin versetzt ist.
26. Kran (14) nach Anspruch 25, in welchem der Ausleger bzw. das Portal (15) eine Rahmenkonstruktion aus Konstruktionselementen ist, einschließlich der oberen (17) und der unteren (18) Schiene, wobei die Schienen die obere und untere Bahn definieren, die in etagenförmiger Beziehung angeordnet sind, und ein Wagen entlang jeder jeweiligen Bahn bewegbar ist.
27. Kran (14) nach Anspruch 25 oder Anspruch 26, in welchem die Schienen parallele Längsteile sind, die an ihren Enden durch Querteile (25) verbunden sind.
28. Kran (14) nach jedem der Ansprüche 25 bis 27, in welchem das Gerüst an den Schienen befestigt ist, die äußerst angeordnet sind.
29. Kran (14) nach jedem der Ansprüche 13 bis 28, in welchem die Bahnen abstützen und jede überspannt ist von einer jeweiligen Fahrwinde, einer oberen Bahn, welche eine relativ breite obere Krankatze (19) darauf aufweist, und einer unteren Bahn, welche eine relativ schmale untere Krankatze (20) darauf aufweist.
30. Kran (14) nach Anspruch 29, in welchem die untere Bahn und die untere Winde innerhalb der Aufhängevorrichtungen vorbeilaufen, die von der oberen Winde abhängen.
31. Kran (14) nach jedem der Ansprüche 13 bis 30, der ein Paar von Laufkatzen (28) umfasst, die auf einem Paar äußerer Schienen, die außerhalb angeordnet sind, und jeweils einer Seite einer inneren Bahn laufen, wobei jede Laufkatze (28) auf einer jeweiligen äußeren Schiene läuft.
32. Kran (14) nach Anspruch 31, der Vorrichtungen zum Bewegen der Laufkatzen (28) in Übereinstimmung zueinander umfasst.
33. Kran (14) nach Anspruch 31 oder Anspruch 32, in welchem die innere Bahn mindestens eine Schiene einschließt, die von oben in jedem bzw. allen Punkten entlang ihrer Arbeitslänge abgestützt ist.
34. Kran (14) nach jedem der Ansprüche 13 bis 33, der für den Einsatz mit vereinheitlichten Elementen von Standardabmessungen geeignet ist.
35. Kran (14) nach Anspruch 34, in welchem die ver-

einheitlichten Elemente Regel-Container sind.

36. Kran (14) nach Anspruch 35, in welchem die Lasteingriffsvorrichtungen zum Herablassen in den Raum zwischen benachbarten gestapelten Containern bzw. Zellgängen fähig sind, der im wesentlichen so breit wie ein Container selbst ist. 5
37. Kran (14) nach Anspruch 36, in welchem eine Reduziervorrichtung auf Aufhängevorrichtungen arbeitet, die die Lasteingriffsvorrichtungen aufhängt. 10
38. Kran (14) nach jedem der Ansprüche 13 bis 37, der eine Kabine des Fahrers umfasst, die befestigt ist an bzw. anders mit jedem jeweiligen Wagen verbunden ist, um der Bewegung dieses Wagens zu folgen. 15
39. Kran (14) nach Anspruch 38, in welchem die Kabinen von den Wagen getrennt sind, und auf vorgesehenen Bahnen laufen. 20
40. Kran (14) nach Anspruch 39, der Vorrichtungen zum Synchronisieren der Bewegung einer Kabine mit der Bewegung eines Wagens umfasst, der von der Kabine gesteuert wird. 25
41. Kran (14) nach jedem der Ansprüche 13 bis 40, der drei oder mehr Hebezeuge umfasst, die in einer verschachtelten Anordnung arbeiten. 30

Revendications

1. Procédé d'actionnement d'une grue (14), le procédé comprenant le déplacement de marchandises ou de produits en une pluralité de charges, dans lequel : chaque charge est transportée par un chariot respectif qui se déplace en va et vient par rapport à la grue (14) le long d'un trajet respectif afin de transférer la charge et de retourner pour une autre charge ; les chariots se croisent alors qu'ils vont et viennent le long de leurs trajets respectifs ; et au moins un chariot change de configuration afin d'éviter une collision avec un autre chariot ou sa charge alors que les chariots se croisent, **caractérisé en ce que** le changement de configuration pour éviter une collision implique le passage d'un chariot à l'intérieur d'un autre chariot. 35 40 45 50
2. Procédé selon la revendication 1, dans lequel chaque chariot comprend un palan mobile, des moyens de suspension pour suspendre une charge au palan et des moyens de mise en prise avec une charge pour la mise en prise avec une charge. 55
3. Procédé selon la revendication 2, dans lequel les moyens de mise en prise avec une charge sont un

agès (23, 24), un grappin ou des moyens destinés à se mettre en prise avec un conteneur.

4. Procédé selon la revendication 2, dans lequel la longueur des moyens de suspension varie afin de modifier la configuration d'un chariot.
5. Procédé selon la revendication 4, dans lequel un chariot change de configuration pour éviter une collision par le fait que les moyens de suspension élèvent ou abaissent les moyens de mise en prise avec une charge.
6. Procédé selon la revendication 5, dans lequel les moyens de suspension comprennent des premier et deuxième câbles, un de chaque côté des moyens de mise en prise avec une charge, et les deux câbles sont allongés ou raccourcis en même temps afin d'élever ou d'abaisser la charge.
7. Procédé selon la revendication 4, dans lequel le chariot change de configuration pour éviter une collision lorsque les moyens de suspension déplacent les moyens de mise en prise avec une charge transversalement à la direction générale de déplacement du chariot.
8. Procédé selon l'une quelconque des revendications précédentes, dans lequel les chariots se déplacent indépendamment les uns des autres.
9. Procédé selon l'une quelconque des revendications précédentes, dans lequel les chariots vont et viennent dans une plage de déplacement qui est sensiblement plus grande que les charges transportées.
10. Procédé selon l'une quelconque des revendications précédentes, dans lequel la configuration des chariots pour éviter une collision est commandée automatiquement et la configuration suit un modèle prédéterminé mémorisé alors que les chariots vont et viennent.
11. Procédé selon l'une quelconque des revendications précédentes, dans lequel la commande de la configuration des chariots pour éviter une collision comprend la surveillance automatique du dégagement entre les chariots qui se croisent y compris les charges qu'ils transportent.
12. Procédé selon l'une quelconque des revendications précédentes, dans lequel les charges sont transportées par leurs chariots respectifs dans la plage de déplacement des chariots.
13. Grue (14) adaptée pour déplacer des marchandises ou des produits en une pluralité de charges, la grue (14) comprenant une pluralité de chariots mobiles

chacun en va et vient par rapport à la grue (14) le long d'un trajet respectif afin de transférer une charge et de retourner pour une autre charge, les chariots se croisant alors qu'ils vont et viennent le long de leurs trajets respectifs ; et des moyens pour modifier la configuration d'au moins un chariot afin d'éviter une collision avec un autre chariot ou sa charge alors que les chariots se croisent, **caractérisée en ce que** le changement de configuration pour éviter une collision implique le passage d'un chariot à l'intérieur d'un autre chariot.

14. Grue (14) selon la revendication 13, dans laquelle chaque chariot comprend un palan mobile, des moyens de suspension pour suspendre une charge au palan et des moyens de mise en prise avec une charge pour la mise en prise avec une charge.

15. Grue (14) selon la revendication 14, comprenant des moyens pour modifier la longueur des moyens de suspension afin de modifier la configuration d'un chariot.

16. Grue (14) selon la revendication 15, dans laquelle les moyens de suspension comprennent des premier et deuxième câbles, un de chaque côté des moyens de mise en prise avec une charge.

17. Grue (14) selon la revendication 16, comprenant des moyens pour modifier la longueur des premier et deuxième câbles en même temps.

18. Grue (14) selon la revendication 16, comprenant des moyens pour modifier les longueurs relatives des premier et deuxième câbles.

19. Grue (14) selon l'une quelconque des revendications 13 à 18, dans laquelle les moyens de mise en prise avec une charge sont un agrès (23, 24), un grappin ou des moyens pour la mise en prise avec un conteneur.

20. Grue (14) selon l'une quelconque des revendications 13 à 19, dans laquelle les chariots sont mobiles le long de pistes respectives qui sont dans une relation imbriquée.

21. Grue (14) selon la revendication 20, dans laquelle les chariots sont mobiles le long de pistes respectives qui sont dans une relation étagée.

22. Grue (14) selon l'une quelconque des revendications 13 à 21, comprenant des moyens anti-collision commandés automatiquement associés à des moyens de mémorisation pour mémoriser un modèle prédéterminé de configuration de chariot.

23. Grue (14) selon l'une quelconque des revendica-

tions 13 à 22, comprenant des moyens de surveillance automatique pour surveiller le dégagement entre les chariots qui se croisent y compris les charges qu'ils transportent.

24. Grue (14) selon l'une quelconque des revendications 13 à 23, comprenant des moyens anti-collision adaptés pour garantir que la configuration d'un chariot est modifiée pour éviter une collision alors que ce chariot atteint une séparation minimum d'un autre chariot qui approche.

25. Grue (14) selon l'une quelconque des revendications 13 à 24, comprenant une flèche ou un portique allongé élevé (15) qui s'étend horizontalement en porte-à-faux depuis un support vertical décalé vers une extrémité.

26. Grue (14) selon la revendication 25, dans laquelle la flèche ou le portique (15) est une structure d'éléments de construction comprenant des rails supérieurs (17) et inférieurs (18), les rails définissant des pistes supérieures et inférieures disposées dans une relation étagée et un chariot étant mobile le long de chaque piste respective.

27. Grue (14) selon la revendication 25 ou la revendication 26, dans laquelle les rails sont des éléments longitudinaux parallèles reliés à leurs extrémités par des éléments transversaux (25).

28. Grue (14) selon l'une quelconque des revendications 25 à 27, dans laquelle le support est fixé aux rails qui sont disposés le plus à l'extérieur.

29. Grue (14) selon l'une quelconque des revendications 13 à 28, dans laquelle les pistes supportent et sont enjambées chacune par un palan mobile respectif, une piste supérieure supportant un chariot roulant supérieur relativement large (19) et une piste inférieure supportant un chariot roulant inférieur relativement étroit (20).

30. Grue (14) selon la revendication 29, dans laquelle la piste inférieure et le palan inférieur passent à l'intérieur des moyens de suspension qui pendent du palan supérieur.

31. Grue (14) selon les revendications 13 à 30, comprenant deux chariots de levage (28) se déplaçant sur deux rails extérieurs disposés à l'extérieur et un de chaque côté d'une piste intérieure, chaque chariot de levage (28) se déplaçant sur un rail extérieur respectif.

32. Grue (14) selon la revendication 31, comprenant des moyens pour déplacer les chariots de levage (28) en conformité l'un avec l'autre.

33. Grue (14) selon la revendication 31 ou la revendication 32, dans laquelle la piste intérieure comprend au moins un rail supporté par le dessus en des points quelconques ou en tous points le long de sa longueur fonctionnelle. 5
34. Grue (14) selon l'une quelconque des revendications 13 à 33, adaptée pour être utilisée avec des articles regroupés de dimensions standard. 10
35. Grue (14) selon la revendication 34, dans laquelle les articles regroupés sont des conteneurs standard.
36. Grue (14) selon la revendication 35, dans laquelle les moyens de mise en prise avec une charge sont capables d'être abaissés dans un espace entre des conteneurs empilés voisins ou des glissières cellulaires qui est sensiblement aussi large qu'un conteneur lui-même. 15 20
37. Grue (14) selon la revendication 36, dans laquelle des moyens de réduction agissent sur les moyens de suspension auxquels les moyens de mise en prise avec une charge sont suspendus. 25
38. Grue (14) selon l'une quelconque des revendications 13 à 37, comprenant une cabine de conduite fixée ou autrement associée à chaque chariot respectif de manière à suivre le mouvement de ce chariot. 30
39. Grue (14) selon la revendication 38, dans laquelle les cabines sont séparées des chariots et se déplacent sur des pistes dédiées. 35
40. Grue (14) selon la revendication 39, comprenant des moyens pour synchroniser le mouvement d'une cabine avec le mouvement d'un chariot que commande la cabine. 40
41. Grue (14) selon l'une quelconque des revendications 13 à 40, comprenant trois agrès ou plus fonctionnant dans un agencement imbriqué. 45

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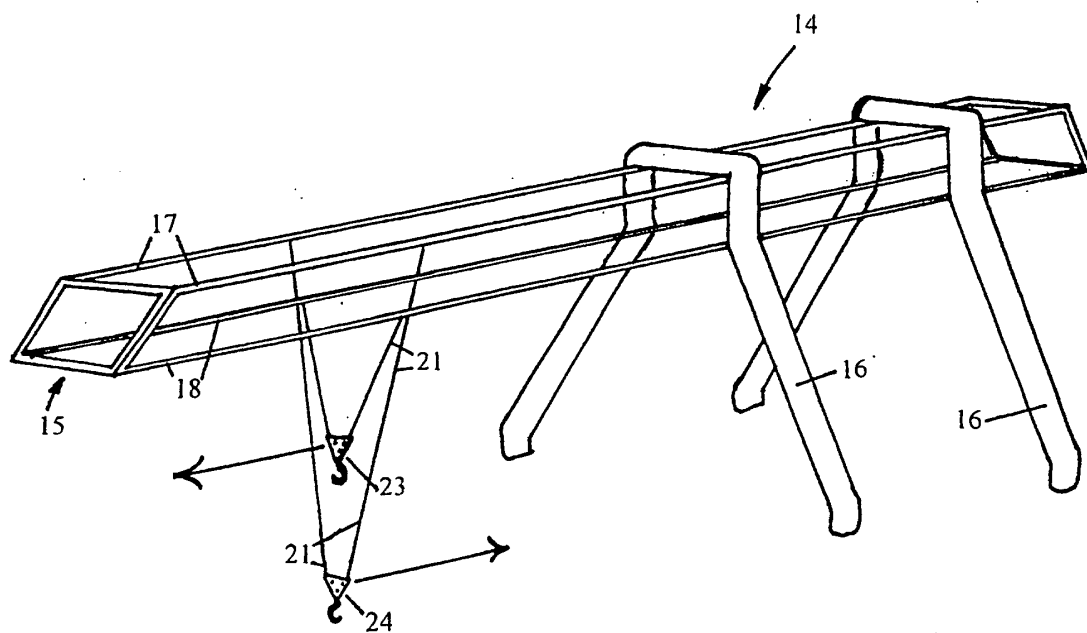


Figure 1

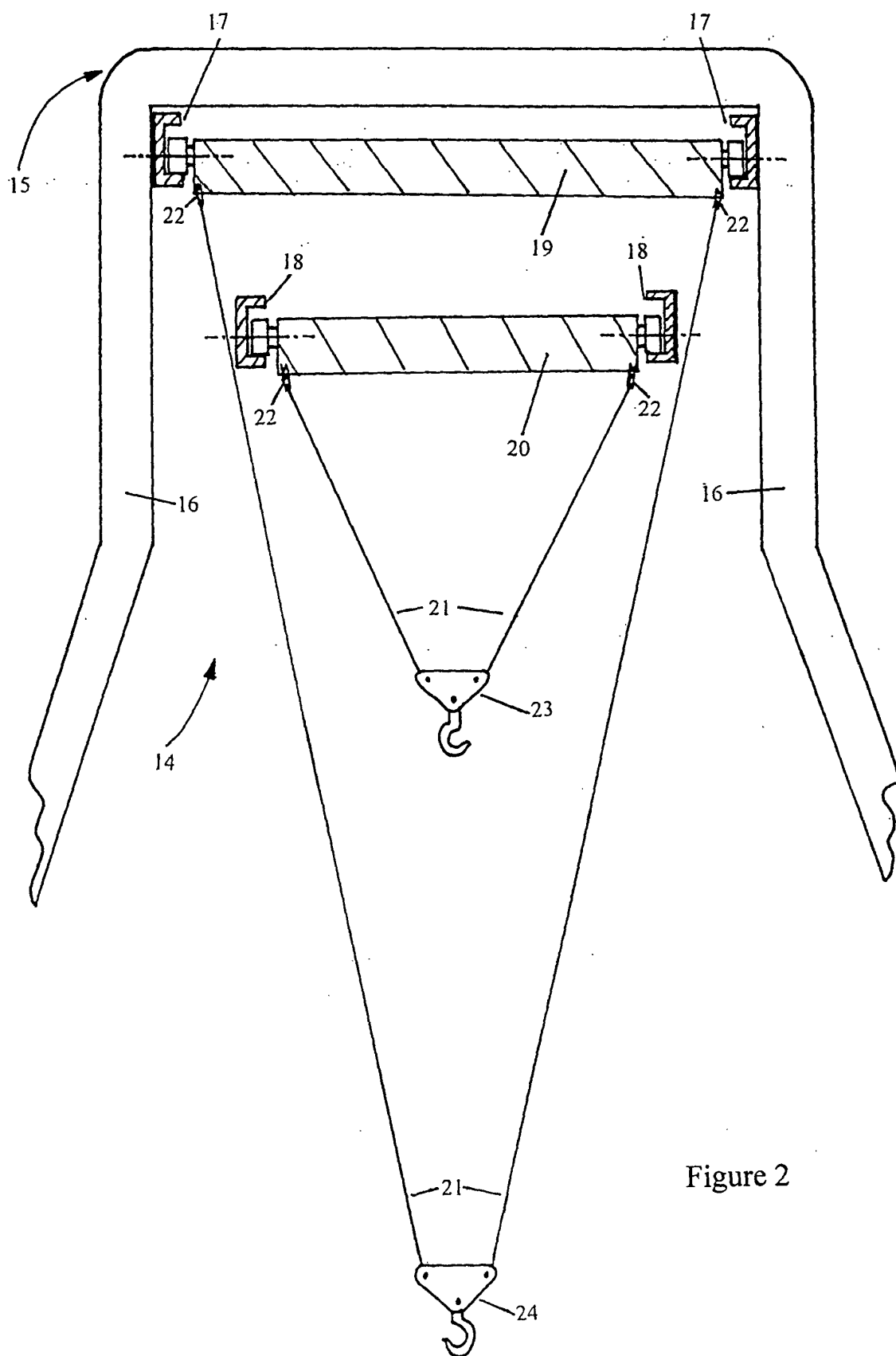


Figure 2

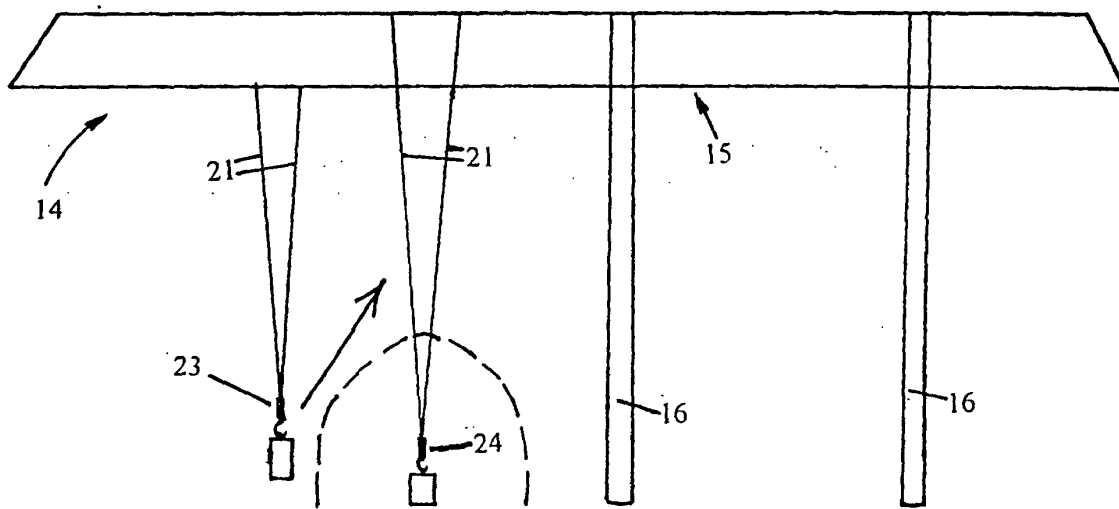
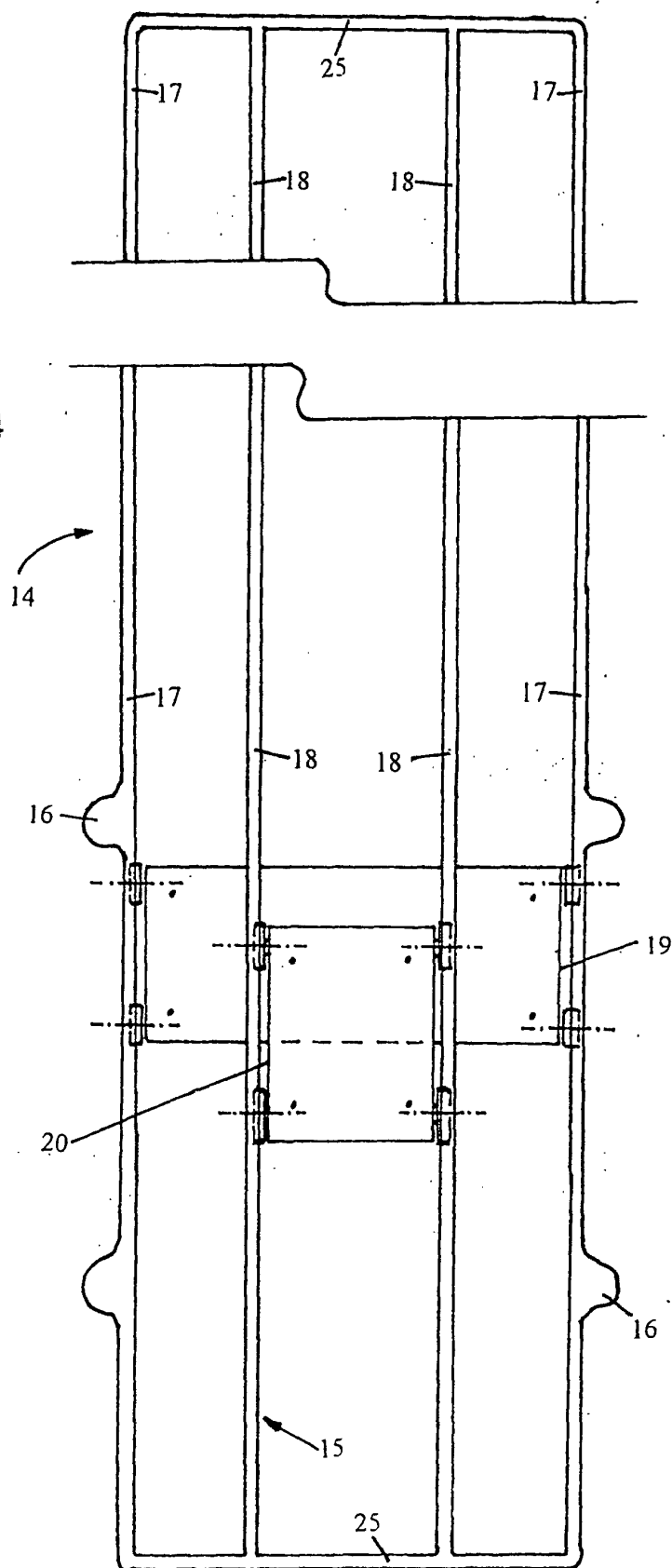


Figure 3

Figure 4



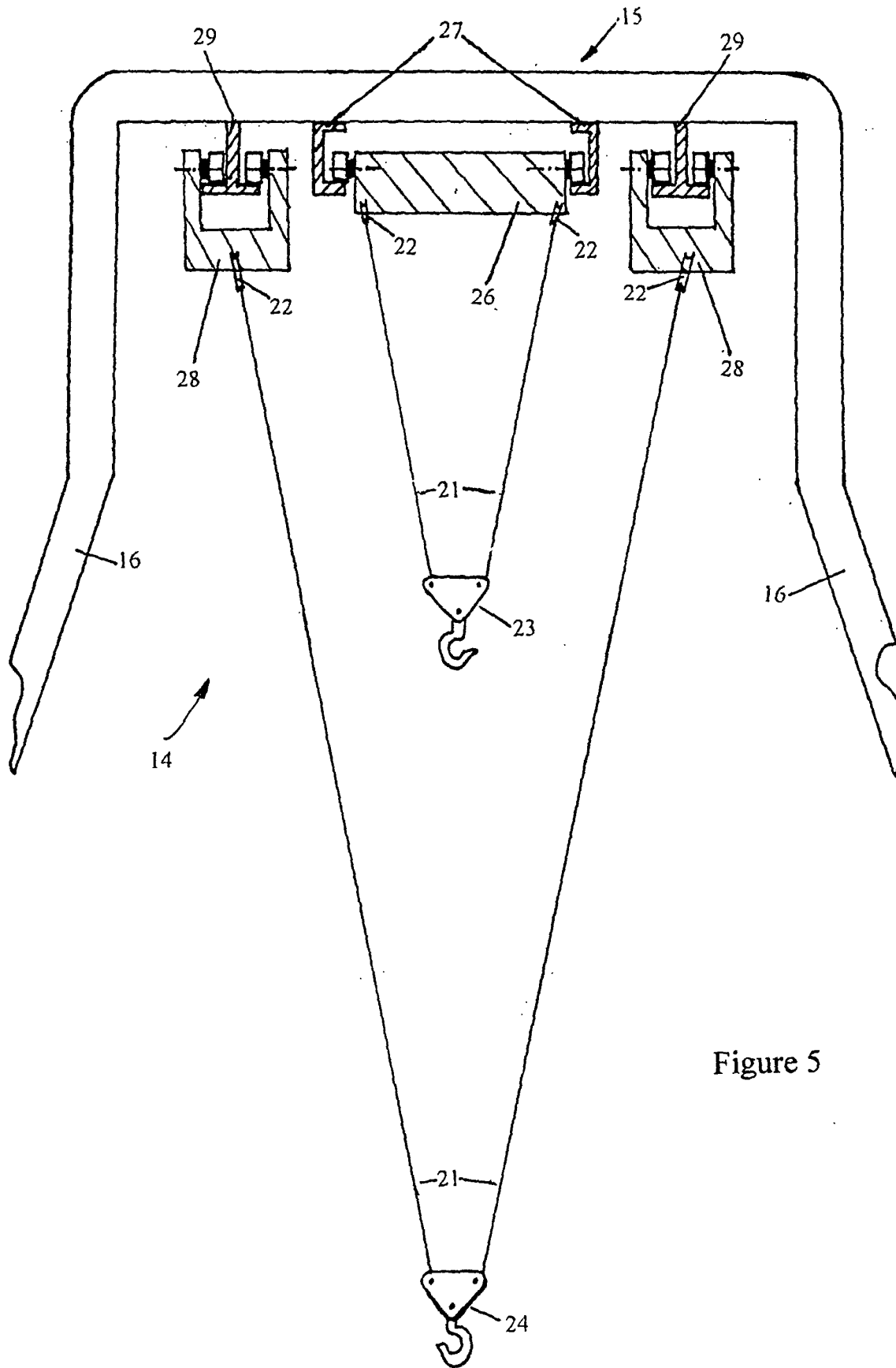


Figure 5

Figure 6

