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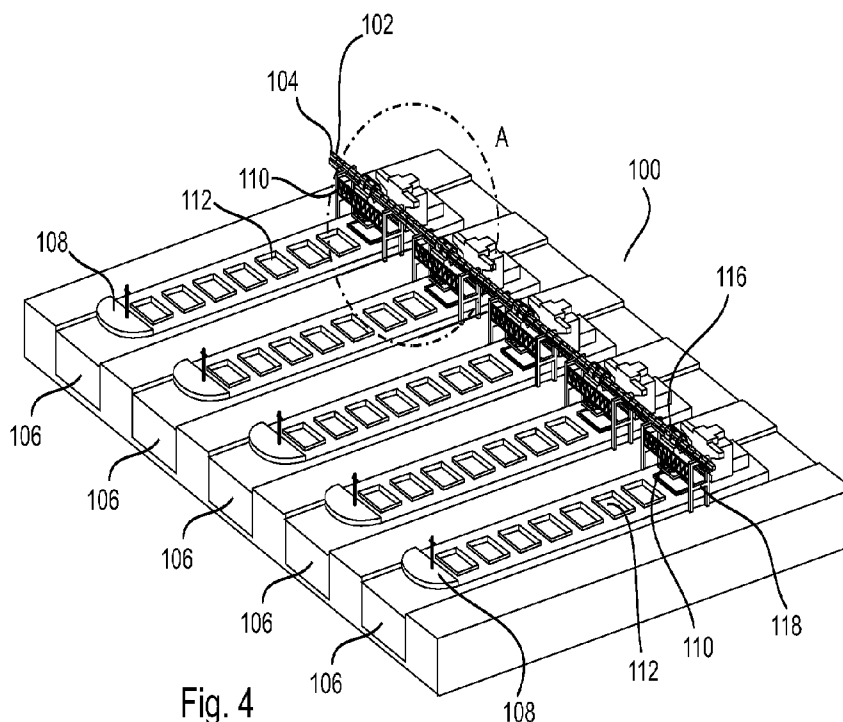


Fig. 4

(57) Abstract: A system and method of transferring bulk material cargo from railway to maritime vessel without the need to stock-pile the material prior to loading. A cargo supply means (102) supports at least one railway track (104) over at least one said vessel (108) in a dock (106). The railway track (104) connects to track of a railway infrastructure for the provision of loaded railway wagons to be unloaded into the hold(s) of the vessel(s). Railway wagon unloading means, such as a rotary tippler (116), unloads the material. The load is directed by a cargo transfer means (110) of the cargo supply means (102) into the hold(s) (112) of the vessel(s) (108).



## **PORT INFRASTRUCTURE SYSTEM**

### **TECHNICAL FIELD**

The present invention relates to a port infrastructure system for the transfer of  
5 bulk materials, such as coal, iron ore and grain, from railway for transport by  
maritime vessels.

### **BACKGROUND**

Current port infrastructure systems associated with bulk shipping are  
10 typically alongside a wharf whereby the vessel and the wharf are substantially  
parallel and adjacent to each other. This arrangement provides full access to one  
side of a docked vessel allowing a cargo hold to be filled with a raw material,  
usually by large and costly specialist machinery such as a reclaimer and a ship  
loader. Present bulk shipping wharf layouts differ from each other in respect to  
15 the wharf to shore alignment with some wharves being parallel to the shoreline,  
and others being substantially perpendicular to the shore line. Most wharves are  
similar in that they are limited by space restrictions to servicing one vessel at a  
time.

On filling, a bulk carrier vessel's multiple cargo holds are progressively  
20 loaded and care is needed to avoid placing undue stress and strain upon the  
vessel's hull. This results in a time consuming filling process for a cargo vessel.  
The costs associated with waiting bulk carriers compound the inefficiencies of this  
method of ship loading practice.

The present invention attempts to overcome at least in part the  
25 aforementioned disadvantages of existing port infrastructure systems and ship  
loading arrangements.

### **SUMMARY OF THE INVENTION**

In accordance with one aspect of the present invention there is provided a  
30 port infrastructure system including a wharf having an elongate vessel engaging  
portion, wherein at least one vessel docking means is arranged to have a first  
proximal lateral wharf edge spaced apart and joined by at least one vessel  
loading means, thereby defining a docking bay to receive a cargo vessel.

In accordance with a further aspect of the present invention there is provided a ship loading system comprising a wharf having an elongate vessel engaging portion, wherein a plurality of cargo supply means are arranged in series connection with a plurality of vessel loading means thereby forming part of a cargo circuit extending beyond the length of the elongate vessel engaging portion

In accordance with a still further aspect of the present invention there is provided a port infrastructure system separated from and joined to a natural body of water by a canal or lock arrangement.

Another form of the present invention provides a cargo transfer system configured to load at least one maritime cargo vessel with cargo from a railway supply system, the cargo transfer system including at least one vessel dock to receive and retain the at least one maritime vessel in a required position, a cargo supply means configured and arranged to support at least one railway track above a respective cargo hold of the at least one vessel and having a cargo transfer means to direct cargo unloaded from at least one railway wagon positioned on a said railway track and above the respective cargo hold of the at least one vessel, the cargo transfer means having cargo guide means to direct the unloaded cargo into the respective hold of the vessel.

At least one form of the present invention avoids the need to stockpile cargo, such as bulk materials (e.g. coal, iron ore, grain) in large heaps prior to loading onto a vessel. Such stockpiles require significant land area, equipment and time to manage unloading the cargo from railway wagons, creating a stockpile, moving the stockpile supply to a feed area, feeding the cargo from the stockpile via conveyor to the vessel for loading. With the present invention, cargo can be transferred directly from railway wagons to the cargo holds of vessel(s) without needing the delay, equipment and complexity of stockpiling.

The system may include multiple railway tracks adjacent to one another preceding the cargo supply means, such that multiple trains of cargo wagons can be retained on hand until a vessel is positioned in a dock or a particular train is directed to a required railway track over a vessel.

One or more said cargo supply means may include at least one vibrator arranged and configured to vibrate cargo through the cargo supply means to be

discharged to the respective vessel hold. Such vibrator(s) may be electrically, hydraulically or mechanically driven, and may include at least one mechanism to vibrate or shake a cargo guide or conduit arranged to direct cargo downwards in a required flow path.

5           The cargo supply means may support multiple railway tracks over the at least one vessel retained in the respective dock(s). Such railway tracks may be arranged in parallel to one another, and which may be laterally spaced with respect to one another to be aligned over adjacent cargo hold openings of the vessel(s).

10           The cargo supply means may include at least one overhead structure, preferably constructed from steel and/or concrete. The at least one overhead structure may bridge over on or more docks and preferably over multiple vessels when in position.

          The cargo supply means may be mobile or fixed. For example, the cargo  
15 supply means may be arranged and configured to move laterally in line with and over the at least one vessel i.e. laterally with respect to the railway track coming to and leaving from the cargo support means. The cargo supply means may therefore move to align with more than one railway track coming to and leaving from the cargo supply means.

20           The at least one cargo supply means may include one or more feeders arranged to direct the supply of cargo into the hold of the respective vessel. Such feeders may include directable feed heads, which may include one or more vibrators to help prevent clumping of the cargo being delivered to the vessel hold.

          Railway vehicle indexing means may be provided. Such indexing means  
25 can ensure that the correct number of railway wagons are positioned and unloaded in each unloading movement. For example, a rotary tippler may be used to rotate and dump one or more railway wagons simultaneously. Alternatively, a bottom dumping discharge system may be used whereby railway wagons are advanced over delivery chutes. The railway wagons have bottom  
30 chutes or doors that are opened to discharge their load into the delivery chutes to supply the bulk material into the hold (s) of one or more vessels. Wagon advance indexing means ensures that the correct loaded wagons are positioned for dumping their load. Rotary tippler or other unloading means may be provided

above multiple cargo holds on the vessel(s). Thus, multiple unloading operations can be carried out simultaneously, and preferably across multiple laterally spaced railway tracks, thereby speeding up loading of the vessel and maintaining supply of cargo via the railway system whilst reducing delay to trains supplying the cargo supply means.

Merry go round or MGR wagons may be used. Such wagons are arranged and configured to unload whilst on the move. A lever system is used whereby one or more levers are used on each wagon to open and close discharge doors to unload the cargo. This allows the locomotive(s) to continue moving whilst unloading is carried out.

Maritime vessels may be guided into the respective docks, and may be propelled into the respective docks. For example, each dock may be provided with vessel engagement and movement means, such as driven rollers or a motorized vehicle on the upper surface of the dock to pull the respective vessel into position below the cargo supply means. Thus, the vessel(s) can be accurately positioned prior to being loaded.

Bulk material cargo may be supplied to at least one maritime vessel by a method including: moving at least one loaded railway wagon onto a transfer means above a vessel, unloading the at least one railway wagon directly above the vessel, directing the unloaded bulk material as cargo into at least one hold of the vessel.

The bulk material being unloaded may be vibrated to ensure flow of the material into the hold.

A cargo supply means may be provided to support at least one railway track over at least one said vessel, the railway track arranged to connect to track of a railway infrastructure for the provision of loaded railway wagons to be unloaded into the hold(s) of the vessel(s), and a railway wagon unloading means may be provided. Load may be directed by a cargo transfer means of the cargo supply means into the hold(s) of the vessel(s).

The cargo supply means may be arranged to support multiple railway tracks to supply multiple holds of one or more said vessels at any one time. Each of the multiple railway tracks may lead to its own dedicated cargo supply means. Alternatively, more than one cargo supply means may be shared by multiple

incoming railway tracks, controlled by a signalling system so that only one railway train is on the track for unloading on the supply means at any one time.

One or more sections of the cargo supply means may be arranged and configured to be raised up to allow superstructure of the vessel to pass beneath.

5 Such raisable section(s) can include a section of railway track for each respective raisable section. Alternatively, such sections may swing or rotate to allow superstructure of the vessel(s) to pass. Alternatively, the cargo supply means may be of sufficient height above the vessel superstructure that only portions of the cargo transfer means, such as delivery chutes, pipes, conduits etc need  
10 moving aside or raising to allow the superstructure to pass.

### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

15

**Figure 1** is a plan view of a port infrastructure system in accordance with an embodiment of the present invention;

**Figures 2a & 2b** show an end elevation view of a vessel loading means in operation in accordance with the port infrastructure system embodiment of the  
20 present invention shown in figure 1;

**Figure 3** is a plan view of a port infrastructure system in accordance with a further embodiment of the present invention;

**Figure 4** shows an alternative cargo transfer system according to a further embodiment of the present invention;

25 **Figure 5** shows detail of a section of the cargo transfer system marked 'A' of Figure 4;

**Figures 6a, 6b & 6c** show respective detail sections of a cargo transfer system according to a further embodiment of the present invention; and

30 **Figures 7a, 7b and 7c** show respective sectional views of portions of a cargo transfer system according to a further embodiment of the present invention.

## DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1 there is shown a port infrastructure system 10 in plan view. The system includes a wharf 11 having an elongate vessel engaging portion 12. Spaced along the vessel engaging portion 12 are a plurality of vessel docking means 14. Each docking means 14 having a first lateral wharf edge 40, and a second substantially parallel wharf edge 42, spaced apart and joined by a vessel loading means 16, thereby defining a docking bay 44 to receive a cargo vessel 19.

Further, in Figure 1 there is shown a wharf vessel engaging portion 12 along a longitudinal axis. Spaced along the vessel engaging portion 12 are a plurality of docking bays 44, arranged to receive a plurality of cargo vessels 19 at a substantially perpendicular axis to the vessel engaging portion 12. Each docking bay 44 is dimensioned to safely receive at least the width of a cargo vessel 19. In the preferred embodiment of the present invention, it is envisaged that the cargo vessel 19 is a gearless dry bulk carrier.

As shown in the port infrastructure system 10 of Figure 1 a plurality of cargo supply means 18 extend along the elongate vessel engaging portion 12. In a preferred embodiment of the present invention, it is envisaged the cargo supply means 18 comprises a plurality of individual rail circuits 80 arranged in parallel and connected to a series of vessel loading means 16, thereby allowing concurrent and independent access to each docking bay 44.

Further, in this preferred embodiment of the present invention a plurality of railroad cars 82 (see end views Figures 2a and 2b) convey a cargo from a raw materials rail loading station (not shown) via the individual rail circuits 80 to the vessel loading means 16.

Each individual rail circuit 80 has a clear passage along the length of the vessel engaging portion 12 and is elevated so as to pass over each docking bay 44 via the vessel loading means 16. In the present embodiment it is envisaged the railroad cars 82 will be typically, though not limited to, standard hopper railway cars.

As shown in Figure 1, a preferred embodiment of the vessel loading means 16 includes a support member 60 with a first edge fixed to a proximal wharf edge 40, and a second edge fixed to a distal wharf edge 42. As seen in

Figure 2 an individual railroad car 82 engages with a cargo transfer station 84, typically, but not limited to, a rotary car dumper. The cargo is passed into a temporary storage hopper 62, and then flows through to a cargo hold 94 via vibrator feeders 64.

5 In use, an approaching cargo vessel is intercepted and guided into the vessel engaging portion 12 of a wharf 11 by a plurality of tug boats (not shown), thereby arranging correct positioning and safe passage for the cargo vessel 19 to be received into the docking bay 44.

10 Once positioned in the docking bay 44, the vessel's cargo hold 94 is opened and prepared for filling. Preferably via a remote central control station, an operator may direct one or more railroad cars 82 via rail circuit 80 through a rail loading station (not shown) thereby filling the railroad cars 82 with a raw material for shipping, typically a dry bulk material such as iron ore or coal. Once loaded the railroad cars 82 then travel along an individual rail circuit 80 onto the vessel  
15 engaging portion 12 of wharf 11. Here the railroad cars 82 engage with a vessel loading means 16 and a subsequent cargo transfer station 84, thereby transferring the raw material cargo from the railroad car 82 into the hopper 62 and through the vibrator feeders 64 into the cargo hold 94 of the docked vessel 19.

20 Through a coordinated operation with the tug boat (not shown) operators a cargo vessel 19 is positioned such that the vessel loading means 16 is in direct vertical alignment with the cargo hold 94 to be filled. The filling process is then repeated for each cargo hold to be filled.

25 At any time during the filling process of multiple ships, more than one individual rail circuit may be arranged to fill anyone vessel providing the vibrator feeders 64 are aligned with a cargo hold 94.

The railroad cars 82 continue along the respective individual rail circuit 80 and return to the vessel loading means 16 subsequent to being refilled with raw materials at the rail loading station (not shown).

30 As shown in Figure 3, in an alternative embodiment of the present invention, the port infrastructure system 10 may be located onshore and connect with a natural water source 21 by means of canals 23. In this embodiment of the present invention it is envisaged that use of locks 27 within the canals 23 may overcome any tidal fluctuations impacting the port use.

In Figure 4 can be seen a major portion of a cargo transfer system 100 according to a further embodiment of the present invention. A cargo supply means 102 supports a railway track 104 over multiple maritime vessel berths or docks 106 lying laterally adjacent to one another. Each dock holds a vessel 108.

5 The cargo supply means 102 includes five cargo transfer means 110. A respective cargo hold 112 of each vessel 106 is positioned directly below a respective cargo transfer means 110. Each cargo transfer means includes equipment 116 to unload one or more railway wagons of a train 114 moved onto the supported railway track 104. A rotary tippler 116 for one or two wagons is preferred, though side tipping equipment may be used. A concrete and/or steel

10 structure 118 as part of the cargo supply means is built to support the railway track over each vessel. Each structure 118 includes guides, chutes and/or conduits to direct cargo unloaded from the railway wagons into the waiting hold of the vessel beneath. One or more vibrators can be used to help maintain flow of

15 cargo, such as bulk material (e.g. grain, coal, iron ore) through the guides and chutes etc. Sometimes such materials can clump together or aggregate to block flow. Vibrators can help to prevent such blockage.

As seen in Figures 6a-6c, the vessels 106 are aligned laterally with respect to one another. Figure 6a shows a plan view, figure 6b a front or end view and

20 figure 6c a side view of the port infrastructure or cargo transfer system according to an embodiment of the present invention. In particular, figure 6b shows clearly the cargo transfer means 110 positioned above a respective hold 112 of a vessel 108 contained in each dock 106.

Figures 7a-7c show detail of sections of the system according to a further

25 embodiment of the present invention. In figure 7a, a longitudinal cross section through a dock shows the vessel 108 in the dock 106 with the cargo supply means 102 over the vessel. Detail 'B' in figure 7a is shown in close up as figure 7b. Here can be seen an end on view of a rotary tippler 116 for rotating and unloading railway wagons 120 containing the cargo to be loaded onto the vessel.

30 A railway wagon 120 can be seen end on in figure 7b. Cargo unladen from the wagon travels down through opening 122 and is transferred to chutes 124 for unloading at multiple points into the hold below. Vibrators 126 help to maintain flow and prevent blockage. Figure 7c shows a close up section C-C of figure 7a.

Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention

CLAIMS:

1. A cargo transfer system configured to load at least one maritime cargo vessel with cargo from a railway supply system, the cargo transfer system including at least one vessel dock to receive and retain the at least one maritime vessel in a required position, a cargo supply means configured and arranged to support at least one railway track above a respective cargo hold of the at least one vessel and having a cargo transfer means to direct cargo unloaded from at least one railway wagon positioned on a said railway track and above the respective cargo hold of the at least one vessel, the cargo transfer means having cargo guide means to direct the unloaded cargo into the respective hold of the vessel.
2. A system according to claim 1, including multiple railway tracks adjacent to one another preceding the cargo supply means whereby multiple trains of cargo wagons can be retained on hand until a vessel is positioned in a dock or a particular train is directed to a required railway track over a vessel.
3. A system according to claim 1 or 2, wherein said cargo supply means includes at least one vibrator arranged and configured to vibrate cargo through the cargo supply means to be discharged to the respective vessel hold.
4. A system according to claim 3, wherein the vibrator(s) is/are electrically, hydraulically or mechanically driven.
5. A system according to claim 4, including at least one mechanism to vibrate or shake a cargo guide or conduit arranged to direct cargo downwards in a required flow path.
6. A system according to claim 1, wherein the cargo supply means supports multiple railway tracks over the at least one vessel retained in the respective dock(s).

7. A system according to claim 6, wherein the railway tracks are arranged parallel to one another.
8. A system according to claim 1, wherein the cargo supply means has at least one overhead structure constructed from steel and/or concrete.
- 5 9. A system according to claim 8, wherein the at least one overhead structure is arranged and configured to bridge over one or more docks and multiple vessels when in position.
10. A system according to claim 1, wherein the cargo supply means is mobile.
11. A system according to claim 10, wherein the cargo supply means is arranged and configured to move laterally in line with and over the at least one vessel
12. A system according to claim 1, wherein the at least one cargo supply means includes one or more feeders arranged to direct the supply of cargo into the hold of the respective vessel.
- 15 13. A system according to claim 12, wherein the one or more feeders includes respective directable feed heads.
14. A system according to claim 1, further including a railway wagon unloading means positioned above each vessel when docked.
15. A system according to claim 14, the railway wagon unloading means further including a rotary tippler or other unloading means above the docked vessel(s)
- 20 16. A system according to claim 14 or 15, the or each cargo transfer means arranged to unload said railway wagons into multiple cargo holds on the vessel(s) via guides, conduits or chutes.

17. A method of supplying bulk material cargo to at least one maritime vessel, the method including: moving at least one loaded railway wagon onto a transfer means above a vessel, unloading the at least one railway wagon directly above the vessel, directing the unloaded bulk material as cargo into at least one hold of  
5 the vessel.

18. A method according to claim 17, including vibrating the unloaded bulk material to ensure flow of the material into the hold.

19. A method according to claim 17, including providing a cargo supply means to support at least one railway track over at least one said vessel, the railway  
10 track arranged to connect to track of a railway infrastructure for the provision of loaded railway wagons to be unloaded into the hold(s) of the vessel(s), and providing a railway wagon unloading means, and unloading the railway wagon(s) whereby the load is directed by a cargo transfer means of the cargo supply means into the hold(s) of the vessel(s).

20. A method according to claim 19, whereby the cargo supply means supports multiple railway tracks to supply multiple holds of one or more said vessels at any one time.

21. A port infrastructure system including a wharf having an elongate vessel engaging portion, wherein at least one vessel docking means is arranged to have  
20 a first proximal lateral wharf edge spaced apart and joined by at least one vessel loading means, thereby defining a docking bay to receive a cargo vessel.

22. A ship loading system comprising a wharf having an elongate vessel engaging portion, wherein a plurality of cargo supply means are arranged in series connection with a plurality of vessel loading means thereby forming part of  
25 a cargo circuit extending beyond the length of the elongate vessel engaging portion

23. A port infrastructure system according to claim 21 or a ship loading system according to claim 22, selectively separated from and joined to a natural body of water by a canal or lock arrangement.

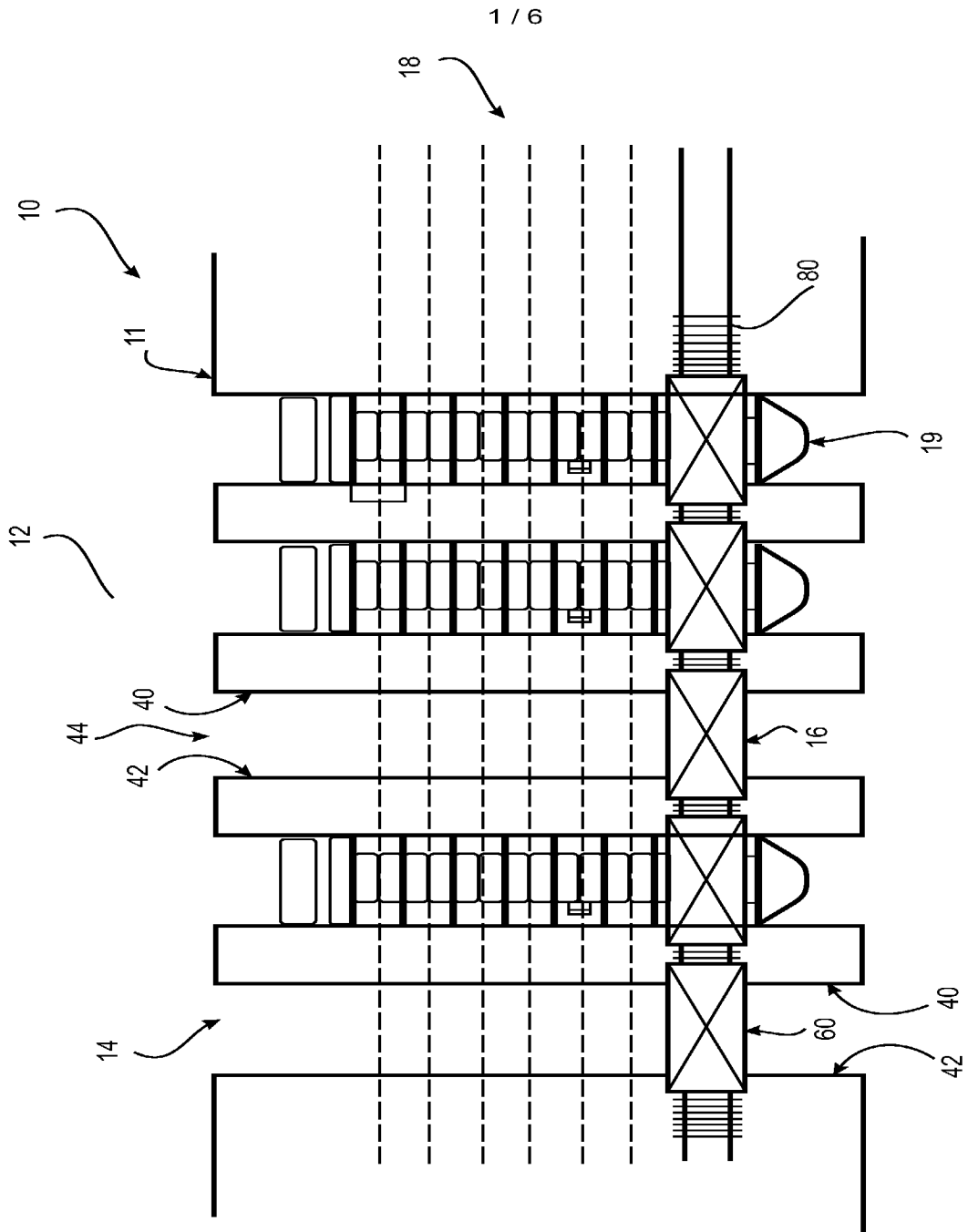


Fig. 1

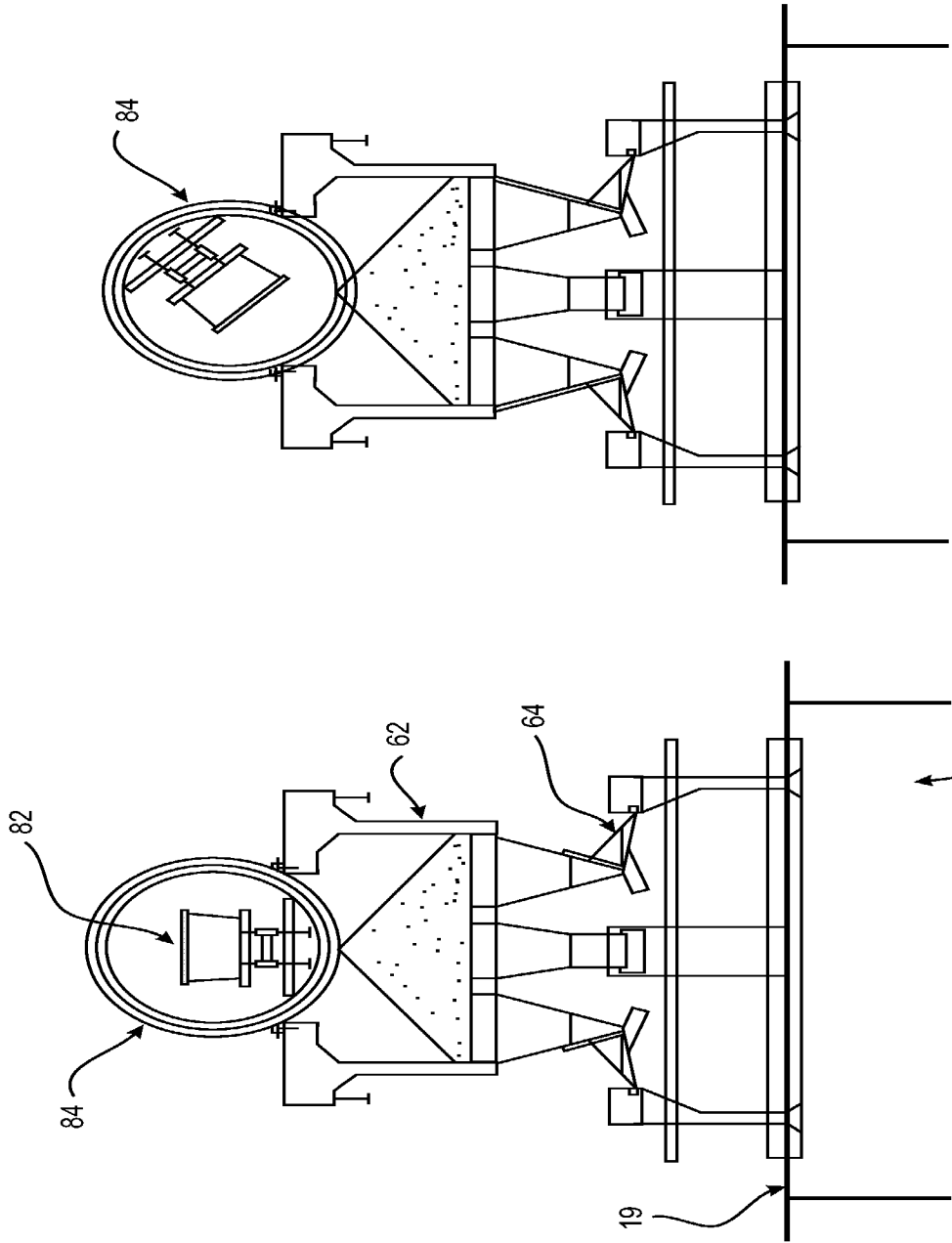


Fig. 2b

Fig. 2a





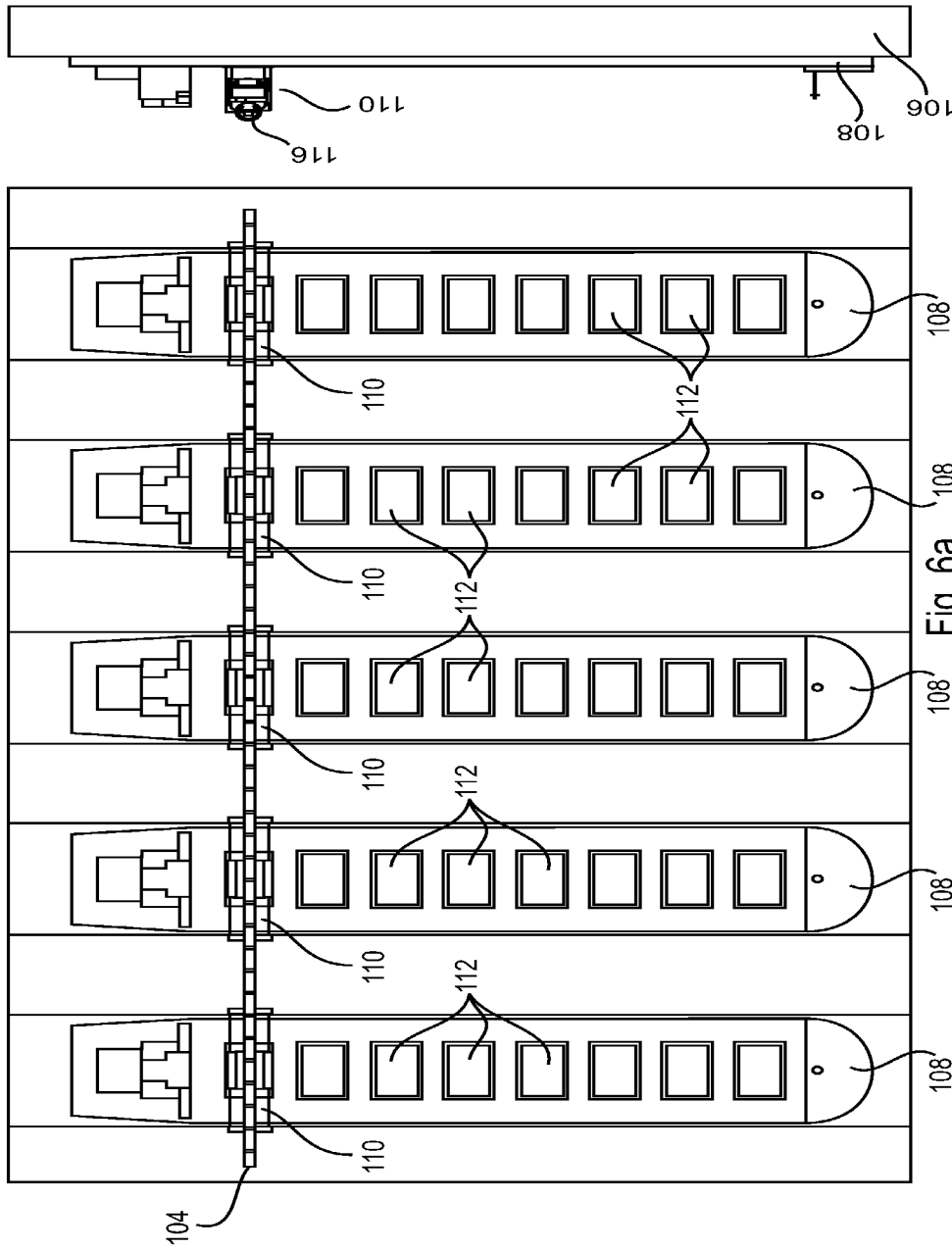


Fig. 6c

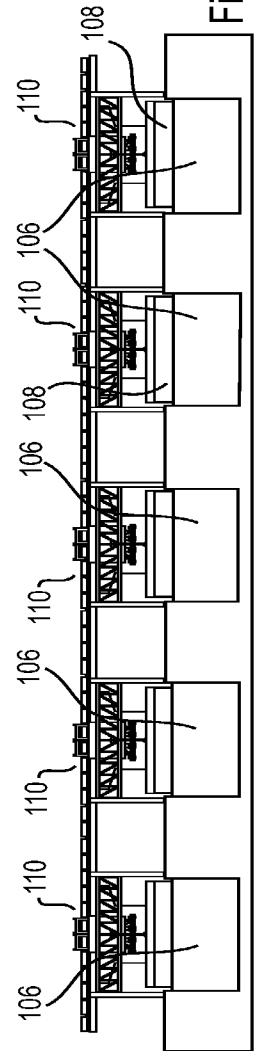


Fig. 6b

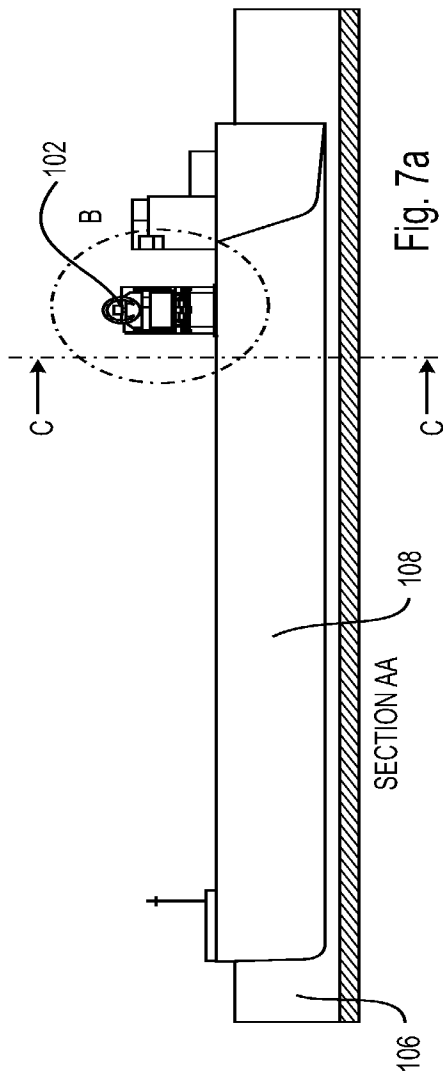


Fig. 7a

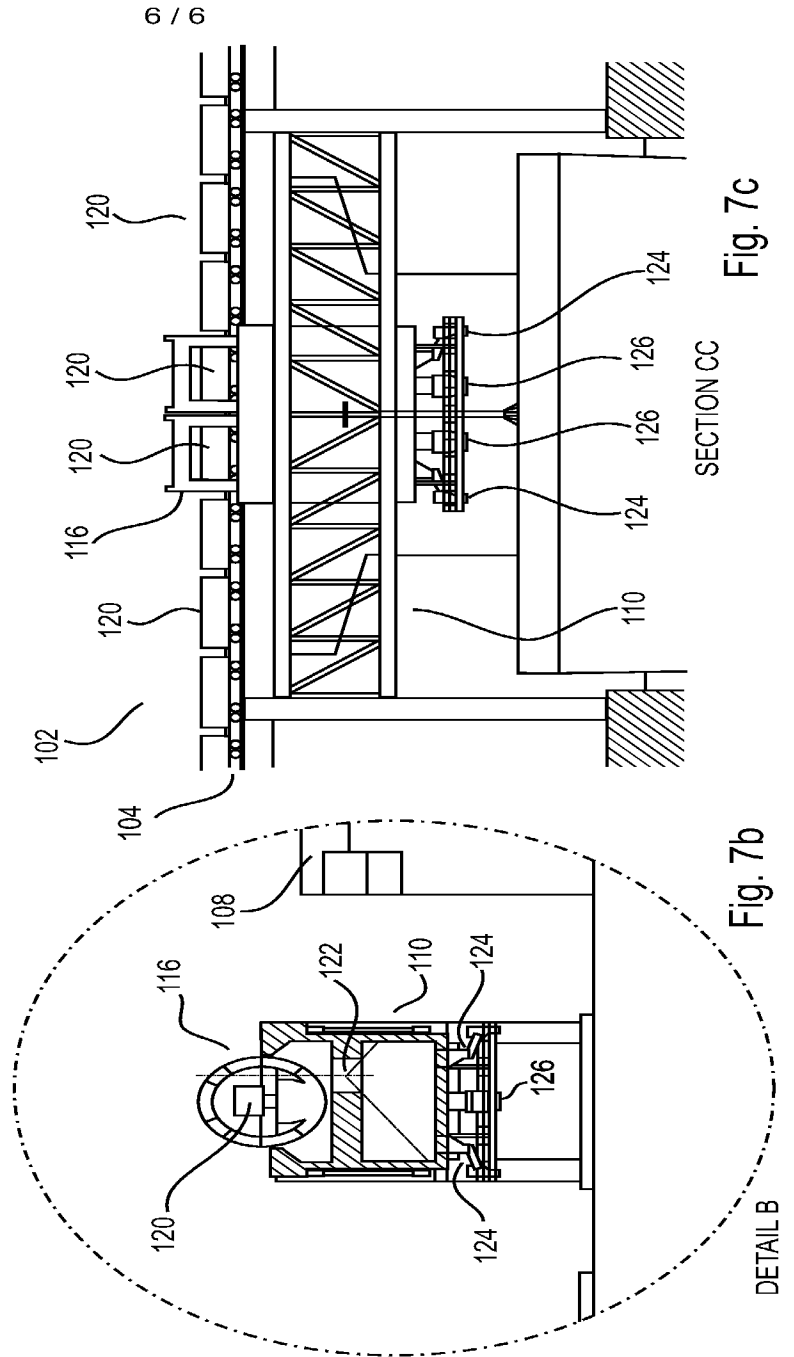


Fig. 7c

Fig. 7b

DETAIL B