## TITLE OF THE INVENTION

A Method for Buffer Crane Operation in Cargo Container Handling

## CROSS REFERENCE TO RELATED APPLICATIONS:

This application is related to US Patents Serial Nos. US 6,602,036 B2; US 6,652,211 B2; and US 6,685,418 B2.

## BACKGROUND OF THE INVENTION

### FIELD OF THE INVENTION

The present invention relates to a supplemental sub-operation for cargo container handling by gantry cranes for improving the efficiency of the container handling cycle time. More particularly, it relates to a new method of operation for dockside quay cranes. Specifically, it relates to the supplemental operation of a buffer crane which functions in conjunction with cargo container handling gantry cranes.

## DESCRIPTION OF THE PRIOR ART

The utilization of various types of cargo container handling gantry cranes or quay cranes for the purpose of increasing the speed of loading and unloading of cargo container transport ships is well-established in the prior art. However, despite the numerous designs, structures, and methods of operation disclosed by the prior art, which have been developed for the accomplishment of the specific objectives, purposes, and requirements of cargo container handling, the apparatus and methods which have heretofore been devised and utilized consist basically of familiar, expected, and obvious configurations, combinations, and arrangements of well-known machinery operations. This will become apparent from the following consideration of the closest known and relevant prior art.

Shipping companies wish to reduce the time a ship spends in port involved in berthing operations in order to increase the efficiency of each vessel. Increasing the productivity of berthing operations allows ships to be loaded and unloaded faster, thereby effectively reducing the ship's down time. Efforts are continuously being made to further this objective. The present invention is a significant advancement in these efforts.

Reference is made to FIG. 1 of the drawings which shows a typical dockside berthing operation for a ship. The primary container handling equipment is

comprised of one or more quay cranes 11 which extend outboard from the dock's edge 13 across the beam of a ship 15. Cargo containers 17 which have been unloaded or are to be loaded are temporarily stored in a stacking yard 19 proximate to the ship's loading berths. The berthing operations under specific consideration involve the transport of containers between a container ship and the stacking yard.

In ship unloading operations, quay cranes 11 access the shipboard cargo containers from above the ship and move them to the ground level or dockside cargo container transporters 21 such as chassis trucks, trailer trucks, or automatically guided vehicles (AGVs). The transporters deliver the containers to the stacking yard 19 where other vehicles or cranes 23 transfer the containers to stacks. In loading operations, quay cranes lift the cargo containers from the dockside container transporters and move them to the ship where they are lowered into shipboard cells. The berthing operations involve three separate types of sub-operations: (1) quay crane handling; (2) transport between the crane and the stacking yard; and (3) storage yard manipulation.

Quay cranes in the form of cargo container handling gantry cranes are arranged to extend over a longitudinal expanse and transfer cargo containers horizontally from one deposition area to another. The largest of such gantry cranes are primarily located dockside in shipping ports around the world as well as in railroad yards. Quay cranes generally have either a horizontal sliding boom or a

cantilever boom, the latter of which can usually be raised by rotating it around its inboard end. Long span yard and quay cranes are typically supported by vertical structures located inboard from the ends of the crane gantry on rail mounted wheels. The present invention can be utilized with any of these basic types of crane designs and operations.

Reference is made to FIG. 2 of the drawings which illustrate a typical cantilever boom type quay crane 11 having a buffer crane 25 of the present invention positioned thereunder. The quay crane cantilevered rotatable boom 27 is supported by the crane superstructure 29 mounted on crane truck wheels 31 which run on dock rails which are disposed parallel to the edge 13 of the harbor dock. The crane superstructure supports a horizontal gantry 33 disposed generally mid-height thereon at an elevated location above the cargo container pickup and deposition areas 35. The gantry is supported from below by the main legs of the superstructure.

In the cantilevered rotatable boom design for quay cranes, sheaves are disposed at the pinnacle 37 of the superstructure of the crane to guide wire rope reeving 39 which is used to lift the outboard or cantilevered end of the boom to the upright raised stowed position. The wire rope reeving raises the cantilevered boom by rotating it about its hinge point 43 at its inboard end proximate to the superstructure.

While, in most typical dockside applications, the gantry of a cargo container handling quay crane is a slidable or a raisable cantilevered boom extending from a crane superstructure to project over a ship, other types of large gantry yard cranes supported at both ends are located in large cargo container storage or transfer areas. All of these cranes are similar to the gantry type crane of FIG. 2 in that they employ a movable trolley 45, usually with a suspended operator's cab 47, which shuttles along the gantry 33 and boom 27 suspending a cargo container lifting spreader 49. The spreader can be raised or lowered from the crane gantry by the operator and engages from above the top of cargo containers 17. The containers are carried by a transporter 21 or are stacked on the dock or shipboard to permit them to be lifted by the trolley for horizontal transport. During loading, the containers are lifted from the transporter and are moved outboard along the gantry to where they are lowered into the cells 51 in a cargo container transport ship. During unloading, the containers are lifted from the cells and moved from shipboard to shore where they are lowered onto the transporters.

The cargo container lift trolley 45, mounted on rails on the crane gantry sections 27, 33, can traverse from one end of the gantry to the other with a suspended container. The cargo container lifting spreader 49 is suspended from the trolley by fleet through wire rope reeving through a detachable headblock which carries the

wire rope suspension sheaves. Different or variable length spreaders can be secured to the headblock to accommodate correspondingly different size containers.

There are two highly interdependent berthing sub-operations: (1) quay crane handling; and (2) transport vehicle movements between the crane and the stacking yard. A delay in one of those sub-operations causes the other to pause and idle which reduces the overall productivity of the entire system. Several factors can cause delays in the two berthing sub-operations including: (1) unsteady or irregular quay crane operations; (2) the time required for effecting interbox connector (IBC) installation and removal processes; (3) delays in stacking yard operations that delay throughput of transport vehicles; (4) the time required for quay cranes performing alignment of containers with transport chassis; (5) congestion of transport vehicles under quay cranes; and (6) various other factors such as machinery operator mistakes or inexperience.

Quay crane container handling rates are measured in cycle rates. Unsteady quay crane operations result because the cranes move containers different distances depending upon the location of the container on a ship varying the cycle rates. For example, as a quay crane loads or unloads each column of containers spaced across the beam of the ship, the hoist travels a longer distance outboard for each successive column of containers and lowers and hoists longer for each container located deeper in the stack. The increased traveling distance and stationary time for the hoist, for

each successive container, adds to the container handling time and the resulting cycle time.

Unsteady quay crane operation, coupled with a constant number of transport vehicles allotted per crane, creates inefficiencies in the overall operation. When quay crane handling rates or cycle time are slow, transport vehicles must wait. In those instances where the quay crane handles containers fast and cycle time is short, and if the number of transport vehicles is insufficient for the cycle time, the quay crane must wait.

The interbox connector (IBC) installation and removal processes cause both quay cranes and transport vehicles to idle. IBCs are cone-shaped devices that lock stacked containers together on the ship. When quay cranes lift containers from the ship, the IBCs are still attached to the bottom of the container. Usually, the quay cranes must lower the container until it is a few feet above the port terminal dock level where a worker crew can reach underneath and remove the IBCs. The installation processes are just the reverse. The IBC operations cause a significant amount of quay crane and transport vehicle idle time to be induced into the system cycle time as well as exposing the workers to the possibility of injury from a swaying or dropped container or any other hazards associated with proximity to a lifted load and to continuous transport vehicle operations.

Delays in stacking yard operations also cause delays in the throughput of container transport vehicles. The vehicles load or unload containers at the stacking yard before returning to the cranes. Disruptions in the flow of transport vehicles to and from the quay crane loading area are caused by numerous factors such as driver inexperience and lack of familiarity with the apparatus and layout of the yard, as well as yard worker inexperience, which cause the delays in the stacking yard operations. If the disruptions are sufficiently severe, then the quay cranes must wait in idle for a transport vehicle to return.

Another source of delay results when quay cranes expend time aligning a suspended container with a container transport chassis during the container positioning and deposition process. The transport vehicles do not park in precise locations under the quay cranes. As a result, each container placement is in a slightly different location. This process of container lifting spreader alignment with the transport vehicle causes time-consuming delay in the quay cranes operation.

Finally, congestion of transport vehicles under the quay crane slows the rate at which containers are moved to and from the container ship. The situation is exacerbated when there are several cranes working in parallel and the ship carries refrigerated containers. The orientation of the refrigerated containers on the ship often requires that vehicle traffic flow two ways under the quay cranes in order to

properly orient the containers on the transport chassis whereas unidirectional flow would create less congestion and danger to the dock workers.

The buffer crane operations and method of cargo container handling contemplated according to the present invention departs substantially from the conventional concepts, designs, and modes of quay crane operation taught by the prior art. In doing so, the present invention provides an apparatus and new method of sub-operation primarily developed for the purpose of improving the overall efficiency of berthing operations by reducing or eliminating the delay problems described above. It accomplishes the result in a different and improved manner and an overall new method of operation for the dockside handling of cargo containers.

The buffer crane of the present invention functions mainly by establishing a temporary storage or holding operation between the quay cranes and the transport vehicles which reduces the interdependence therebetween. The buffer operation in effect constitutes a container reservoir between two of the three berthing sub-operations: quay crane handling and transport between the crane and the stacking yards. The temporary storage reservoir permits the quay crane to take or deposit containers even if no transporter is available, or conversely, for a transporter to extract a container, or deposit one in the reservoir, even if the quay crane is elsewhere. When one of the two sub-operations experiences a delay, the other sub-

operation continues to work with the buffer operation while the delayed sub-operation resolves its problem.

## SUMMARY OF THE INVENTION

In view of the foregoing known and obvious disadvantages inherent in the prior art types of quay cranes and berthing operations presently existing and utilized in seaports, the present invention provides a new crane construction and method of quay crane operation wherein the same can be utilized to improve the efficiency of cargo container ship berthing operations.

The general purpose of the present invention, which will be described hereafter in greater detail, is to provide a new crane apparatus and method for coordinated quay crane operation which has all of the advantages of the prior art mentioned above, as well as many novel features that result in new methods of berthing operations, which are not anticipated, rendered obvious, suggested, or even implied by any of the prior art of quay cranes and port berthing operations either alone or in any combination thereof.

The present invention is a buffer crane sub-operation for cargo container handling. It is a method for dockside buffer crane cargo container handling in combination with a quay crane. The steps comprise providing an independently

movable platform having a multiplicity of cargo container landing positions disposed thereon and a dedicated crane engaged with the platform arranged to move or transfer containers between the platform and cargo container transporters located below the platform. The platform is positioned dockside under the quay crane and containers are moved by the quay crane between the landing positions on the platform and shipboard cells of a dockside berthed ship. Containers are also concurrently moved by the dedicated crane between the platform and cargo container transporters located below the platform.

These more important features of the method of the invention have been broadly outlined in order that the detailed description thereof which follows may be better understood and in order that the present contribution to an improvement in the art may be better appreciated. There are additional features of the method of the invention that will be described hereinafter and which will form supplemental subject matter of the claims appended hereto.

With respect to the claims hereof, and before describing at least one preferred embodiment of the invention in detail, it is to be understood that the invention is not to be limited in its application to the details of construction and to the arrangements of the components which are set forth in the following description or illustrated in the drawings. The invention is capable of being created in other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the

phraseology and terminology employed here are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other forms, structures, methods, and systems for carrying out the several purposes of the method of the present invention. It is important, therefore, that the claims be regarded as including such equivalent steps in the method in so far as they do not depart from the spirit and scope of the present invention.

Further, the purpose of the appended abstract is to enable the United States Patent and Trademark Office, and the public generally, and especially scientists, engineers and practitioners of the art who are not familiar with the patent and legal terms or phraseology, to determine quickly from cursory inspection the nature and essence of the technical disclosure of the application. The abstract is neither intended to define the invention of the specification, which is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

## OBJECTS OF THE INVENTION

It is therefore an important object of the present invention to provide a new sub-operation for shipping port berthing operations which provides a buffer operation between quay crane operations and the container transport vehicles which service a stacking yard.

It is another object of the present invention to provide a buffer operation for quay crane berthing operations which provides an intermediary landing deck forming a cargo container reservoir between quay crane handling and dockside vehicle transport.

It is a further object of the present invention to provide a buffer crane operation to work in conjunction with a quay crane to increase the efficiency of berthing operations by reducing idle time of the quay crane and container transport vehicles.

It is still another object of the present invention to provide a new gantry frame apparatus for the sub-operation method having a protected service deck for port operators to perform IBC installation and removal operations while the containers are landed on the buffer crane whereby neither the quay crane nor the container transporters need to idle during those operations.

And it is yet a further object of the present invention to provide a supplemental independently movable gantry crane which can be supplied to presently existing quay cranes without additional tracks on the dockside and which provides a landing deck for containers and performs a supplemental buffer sub-operation to quay crane operations and permits IBC removal independent of quay crane involvement to increase the efficiency of berthing operations by reducing the quay crane cargo container handling cycle times.

Other objects and advantages of the present invention will become apparent when the method of the present invention is considered in conjunction with the accompanying drawings.

## DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram in plan view of a ship berthing operation and a cargo container stacking yard;

FIG. 2 is a side elevation of a typical quay crane with a typical buffer jib crane of the present invention located thereunder;

FIG. 3 is a is a perspective view of a typical buffer jib crane of the present invention shown in operation; and

FIG. 4 is a perspective view of a cargo container predetermined deposition position on the landing deck of a buffer crane.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is made to the drawings for a description of a preferred embodiment of the apparatus utilized for implementing the method of the present invention wherein like reference numbers represent like elements on corresponding views.

Reference is made to FIGS. 2 and 3 of the drawings which show a quay crane 11 and a buffer jib crane 25 which are located dockside in a shipping port. The buffer crane is low profile so that it can be positioned underneath a quay crane during container handling operations. It is contemplated that a buffer crane could also be utilized in a railroad stacking yard as well as dockside under a large bridge or straddle crane, so the term "quay crane" as used in the claims is intended to include these types of cranes also.

FIG. 3 shows the buffer jib crane in operation. It is essentially a landing deck where containers can be landed and temporarily stored by a quay crane when they are removed from shipboard or where containers picked off ground level transporters can be landed until they are picked up by the quay crane for transport to a ship. The buffer jib crane is a gantry frame forming a raised or elevated upper platform 53 with

a subplatform 55. The buffer crane sits under a quay crane and interposes a container reservoir between the quay crane and the container transport vehicles. The quay crane can take or extract containers therefrom and the buffer crane can deliver containers therefrom to the transporters. It creates a new and additional sub-operation in ship berthing operations which reduces quay crane cycle time in cargo container handling.

The quay crane 11 deposits containers 17 onto the top of the buffer crane or retrieves them from the upper platform 53 called the landing deck. A subplatform 55 disposed below the landing deck is a working area for port operators called a service deck. The landing deck can support multiple containers to function as the container reservoir in the buffer operation. Container transport vehicles 21, such as chassis trucks, trailer trucks, or AGVs, drive alongside the raised platform to either deliver or receive containers to and from the buffer crane landing deck. A dedicated container handling crane 57 engaged with the buffer crane platform moves the containers between the landing deck and the transport vehicles.

Port operators can also perform certain tasks on the containers from the safety of the service deck 55 while the containers rest on the landing deck 53. With current methods of operation, both the quay cranes and transport vehicles must sit idle while the IBCs are installed or removed. The buffer crane system allows port operators to perform IBC installation and removal operations while the containers rest on the

upper platform so that neither the gantry cranes nor the transport systems need to idle during the IBC attachment or removal process. In addition, service personnel can verify container identification, re-mark a container, or perform minor container servicing while it resides in the buffer pool on the landing deck.

The upper platform or landing deck 53 has fore and aft and lateral edges 59, 61, 63. In the preferred embodiment of the present invention, both platforms 53, 55 are supported at the lateral edges 63 thereof by four vertical support columns 65 disposed at the corners of the gantry and which are interconnected at the lower ends thereof by two interconnecting sill beams 67. Each sill beam connects the bottom of two vertical support columns at the lateral edges of the crane and provides structure for the gantry wheel drive area. The integral structure provides structural support for the loads from the dedicated container crane 57, called a slewing jib crane, for the buffer containers 17 deposited on the landing deck 53, and for emergency impact situations and accidental occurrences. The platforms are supported on pneumatic transport wheels 69 for independent movement of the buffer crane 25.

The transport wheels 69 are secured to the sill beams 67 with a gantry drive for independent movement of the buffer crane 25 underneath the quay crane 11 and along dockside 13. The wheels are rubber tires so that the crane can operate without tracks or rails and can turn. Since the quay cranes move along the dock as they unload each successive row of container cells along the length of the ship, the buffer

crane must likewise move along the dock to remain positioned under the quay crane. The buffer crane gantry drive is the arrangement of wheels, gear systems, drive motors, and brakes that allow the entire buffer crane system to move. By varying the speed of the tires, the crane can move in all directions and is omni-directional. A majority of the time, the wheels are aligned parallel to the edge of the dock which allows the gantry frame of the buffer crane to move in the same direction as the quay crane. In order to stay parallel with the quay crane, the buffer crane performs small turns by varying the wheel speeds on each side the crane.

As indicated earlier, the landing deck 53 of the buffer crane stores containers 17 temporarily as a container reservoir or pool thereby functioning as the essential buffer platform. The landing deck is provided with at least one predetermined landing position formed on the landing deck and has position guides to receive and guide containers being lowered onto the landing position. In the preferred embodiment of the invention, a multiple of predetermined landing positions are dispersed over the landing deck. The term "predetermined" means that they are specifically located for automatic control of the crane operation. Generally between two and five parallel landing positions will suffice for the intended purpose of providing a container reservoir or pool. Access to the containers is provided by the attached dedicated independent cargo handling container crane in the form of a slewing jib crane 57 as well as by the quay crane 11 from above. The dedicated

crane has container lifting apparatus 83 arranged to move containers between the landing deck and the transporters located alongside the platform.

The landing deck is wide enough to accommodate several containers in the predetermined landing positions. Access to the bottom of the containers deposited on the landing deck is provided by openings 71 therein at the predetermined positions. Different types of openings in the landing deck may be required depending upon whether the IBC installation and removal operations are manual or automated. Shock absorbing mechanisms diminish the force of the continuous impacts which result from the container landing operations as well as impacts which occur in emergency situations. The pneumatic rubber tires 69 augment the shock absorbing mechanisms. The landing deck protects workers who operate below, on the service deck 55, from exposure to injury and inclement weather.

Reference is made to FIG. 4 of the drawings which shows a container landing position 71 on the landing deck 53. These positions are defined by angular slides 73 that vertically guide the containers into place during landing on the deck to simplify the placement of the containers thereon. During lowering of the containers onto the buffer platform, the bottom edges of the containers engage the guides which stop residual container sway of the suspended load and laterally displace the container into proper alignment onto the respective deposition position. The descending container slides downward along the guides in the vertical direction. Therefore, the

container landing process requires less precision than current methods utilized with container transport vehicles. This saves considerable time by reducing container positioning requirements. It also reduces the work demand on the quay crane operators who currently endure fatiguing conditions. Essentially, much less time is spent on the placement of a container because the quay cranes do not need to perform tedious positioning adjustments. The guides also place the containers in specific locations so that the jib crane may accurately move to the predetermined deposition and pick-up positions above the landing deck by automated control.

The slewing jib crane 57 shown in closer detail in FIG. 3 is engaged with the upper platform 53 of the buffer crane 25 and moves the cargo containers 17 between the landing deck 53 and the transport vehicles 21. The jib crane is comprised of a slewing armature 75 which is comprised of at least a pair of articulated sub-armatures. A main first sub-armature 77 is pivoted on a support post 79 and secured to one of the lateral edges of the landing deck. The inboard end of the first sub-armature is pivoted on the post for rotational movement in a horizontal plane around the post. A second sub-armature 81 has its inboard end secured to the outboard end of the first sub-armature and also is pivoted thereto for rotational movement in a horizontal plane. The second armature supports cargo container lifting apparatus 83 at the outboard end thereof which can rotate more than 180 degrees.

The slewing armature is arranged to provide full two-dimensional horizontal motion to each of the landing deck container deposition positions, and the vehicles below, in order to move or transfer cargo containers between the platform and cargo container transporters located alongside and below the platform. The term "below" includes positions at the sides of the gantry frame at dock level either level with or below the landing and service decks. It is possible that the transporters could travel the dock at a level above the buffer crane landing deck and the term "below" is intended to cover such a landscape, but there is no known comparable situation.

The slewing jib crane 57 articulates by turning each armature at each of three rotation points: the connection between the support post 79 and the inboard end of the first sub-armature 77; the connection between the outboard end of the first sub-armature and the inboard end of the second sub-armature 81; and the connection between the outboard end of the second sub-armature and the cargo container lifting apparatus. The second sub-armature supports the cargo container lifting apparatus at its outboard free end in the form of a lifting spreader suspension block 83 which can rotate more than 180 degrees to turn a suspended lifting spreader 49 and attached cargo containers 17 end-for-end around a vertical axis to reverse the longitudinal orientation thereof. The first and second sub-armatures and the cargo container lifting apparatus are mounted on the support post at a high enough level to permit the lifting spreader suspended from the suspension block to pass above cargo containers

deposited on the landing deck at a level below the supporting structure of any cargo container quay crane it is positioned under.

The cargo container lifting apparatus operates by reeling in and paying out rope from the suspension block 83 that suspends the lifting spreader 49 whereby the apparatus is considered rope driven. The lifting spreaders are mechanisms that engage and hold containers while they are being lifted. Each corner of the spreader has a twist lock to lock onto the container at the corner castings thereof. The lifting spreader can be controlled by the crane operator to reciprocate in the length of its engagement to a container to accommodate different size containers in the lengths of 20 feet, 40 feet, 45 feet, and two containers of 20 feet each, linked end-to-end.

The cargo container lifting apparatus 49, 83, also has the ability to perform incremental adjustments of the container's position to facilitate alignment with the transport vehicles 21. The apparatus accomplishes this result by giving and taking varying amounts of slack in the suspension ropes. In this manner, the apparatus can skew, list, and trim the container, as well as move the container laterally and longitudinally. The lifting device therefore can quickly position containers on transport vehicles thereby eliminating the time-consuming task from the quay crane's cycle time.

The buffer crane 25 includes an automated control system for partial operation of the dedicated crane to position the cargo container lifting apparatus over

preselected positions on the landing deck and to move containers with coordinated motion. The slewing armature 57 moves automatically between predetermined positions above the landing deck 53 to general positions above the various transport vehicles 21. The crane operator only needs to select from the alternative predetermined container deposition positions on the landing deck to perform container engagement and pickup from a position and for container deposition at a selected position. Computer control performs precision alignment of the cargo containers with respect to the landing deck positions and general positioning of the container lifting spreader above the container transporters. The buffer crane operator controls the slewing armature for accurate alignment of the lifting spreader with the transport vehicle for container pickup or deposition. Computer software automatically controls the turning rates of the three armature rotation points to insure that the movement is smooth and linear during both operator and automatic control of the slewing armature.

The slewing jib crane 57 helps reduce traffic congestion of transport vehicles beneath the quay cranes 11 because it has the ability to rotate containers about the vertical axis. When refrigerated containers are handled, transport vehicles often need to flow in opposite or two directions under the quay cranes to accommodate for the different orientations of the refrigerated containers coming off the ships. Because the slewing crane can reorient the containers to correctly position them on a transport

chassis, the buffer crane system will allow traffic to flow in one direction throughout the stacking yard and under the crane, thereby reducing the amount of traffic congestion.

The service deck or work platform 55 is disposed below the landing deck 53 to provide space for IBC attachment and removal operations. As mentioned earlier, with current methods of operation, both the quay cranes and transport vehicles must sit idle while the IBCs are installed or removed. The quay cranes 11 must pause and hold the containers 17 a few feet off the ground so that personnel can manually install or remove the IBCs. The proximity of the personnel to the lifted container is also a safety hazard. The landing deck 53 of the present invention covers the service deck 55 so that the workers are never in a situation where lifted loads are freely suspended overhead, as can occur in present operations, which is an inherently dangerous situation. If the height limitations for the buffer crane are restricted, it is possible that the service deck cannot be located directly below the landing deck. The situation may require a multiple of lowered service decks disposed between the container deposition positions on the landing deck for the service workers to operate from.

In the buffer crane system, the landing deck 53 covers the service deck 55 so that the service worker personnel can install and remove the IBCs from below through the openings 71 in the landing deck 55 while the container rests safely on the

upper platform. This service deck provision of the buffer crane system allows the safe and efficient installation and removal of the IBCs. It provides port operators with a work area within which to remove the IBCs from the cargo containers deposited on the landing deck either by hand or with IBC removal machinery. Machines or robotics can be provided to aid IBC installation and removal operations for further reducing the strain and danger for worker personnel and increasing the speed of quay crane operations. As a result, the quay cranes and transport vehicles do not need to idle or wait while the IBC installation or removal process occurs.

The buffer crane operator works in an operators' cabin 85. It contains all the automotive and the slewing jib crane 57 controls. Logistics are included to help the operator communicate with the quay crane operator and the service deck workers. Since the operator must communicate with so many individuals, it is essential that communication be clear and simplified to insure safety and productivity. Signal lights on the landing deck automatically indicate to the quay crane driver which containers are to be loaded onto the ship or have already been unloaded. There are indicator lights controlled by the service workers which tell the buffer crane operator whether the IBCs have been removed or not so that the operator does not prematurely move the container. The operator cabin provides simplified controls for the crane driver by reason of the computer controlled positioning of the slewing armature at the predetermined deposition positions on the landing deck.

A diesel engine which is coupled to an alternator provides power to the buffer crane system. The engine and alternator couple rests on one of the sill beams along with the fuel tanks. Weather protected steel enclosures protect the diesel engine and alternator couple from wear and possible damage.

During operation of the buffer crane, an electronic system automatically aligns the buffer crane with the quay crane along the cargo container transporter traffic lanes. The system can be comprised of optical, radio, or ultrasonic devices to measure the distance and relative position of the buffer crane to the quay crane. Information is linked to the quay drive system electronically which repositions the buffer crane until it is in the correct position directly below the quay crane trolley track and parallel to the quay crane quay wheels.

Another electronic system insures that there is no interference or collision between the quay crane spreaders. With two devices accessing the buffer platform, the quay crane and slewing jib crane, there is potential for interference and collision. The electronic system will identify the position of the quay crane lifting spreader to ensure that this does not occur.

The buffer crane system has features that improve productivity and safety of port operations. The buffer crane is a stand-alone machine. It can operate with any existing quay cranes. The quay cranes require only minimal modification to accommodate the electronic linking systems. There are no costs involved which

would be due to required extensive crane modifications or crane downtime. Because the buffer crane travels on rubber tires, the buffer operation does not require tracks, so there is no need to install additional rails on the port surface. The buffer crane has the advantage that is easy and inexpensive to install and can be applied to many cargo container handling ports in operation today.

The present invention constitutes a method for dockside buffer crane cargo container handling working in combination with a quay crane. The method is a ship berthing sub-operation and comprises several steps, the first of which is providing an independently movable platform having a multiplicity of cargo container landing positions disposed thereon. The movable platform has a dedicated crane engaged therewith which is arranged to move containers between the platform and cargo container transporters located below the platform. The platform is positioned on the dockside under the quay crane.

Cargo containers are moved by the quay crane between the landing positions on the platform and shipboard cells of a dockside berthed ship. Cargo containers are also moved by the dedicated crane between the platform and cargo container transporters located below the platform concurrently with the movement of containers by the quay crane. The term "concurrently" means that both cranes can be operating and moving containers at the same time. It is only that period of time when the quay crane is depositing or retrieving containers from the platform that the

dedicated crane must remain clear of the platform. The dedicated crane can be operating to deposit or remove a container with respect to a transport vehicle, but the automatic controls of the crane prevent it from mechanically interfering with the quay crane.

The method of the present invention includes the separate step of performing interbox connector installation and removal operations while containers are temporarily positioned on the platform.

The method of the present invention also includes the separate step of independently moving the platform to each operational position of the quay crane on the dock as the quay crane moves along said dock to unload the length of a container ship.

The method of the present invention also includes the separate steps of utilizing three different types of dedicated buffer cranes: (1) a slewing jib crane; (2) a bridge crane; and (3) a straddle crane.

The method for dockside buffer crane cargo container handling in combination with a quay crane therefore resolves many of the delay issues described earlier. Even when one of the sub-operations of quay crane handling or container dockside transport is delayed, the other sub-operation may continue by accessing the containers on the buffer platform. The delayed sub operation can address the delay, and the other crane continue its work. The complete elimination of IBC installation

and removal operations from the quay crane cycle time provides a huge improvement in the efficiency of berthing operations.

In summary, the buffer crane system improves productivity and efficiency of port operations by providing a buffer operation between the quay cranes and transport vehicles sub-operations. This buffer allows quay cranes and vehicles to operate independently so that delays in one sub operation do not slow the overall productivity. Additionally, the buffer allows port operators to perform tasks on containers such as marking and inspection while they sit on the buffer platform rather than having the quay cranes and transport vehicles wait while those operations are performed.

Thus, it will be apparent from the foregoing description of the invention in its preferred form that it will fulfill all the objects and advantages attributable thereto. While it is illustrated and described in considerable detail herein, the invention is not to be limited to such details as have been set forth except as may be necessitated by the appended claims.

WE CLAIM:

1. A method for dockside buffer crane cargo container handling in combination with a quay crane, the steps comprising

providing an independently movable elevated platform formed for independently travelling dockside and having a multiplicity of cargo container landing positions disposed on a landing deck portion thereof for landing a multiple of containers individually and randomly on said positions

providing a dedicated crane engaged with said platform and arranged for top engagement transfer of containers between said platform and cargo container truck transporters located alongside or below said platform,

positioning said platform dockside under said quay crane,

moving containers by said quay crane between said landing positions on said landing deck and shipboard cells of a dockside berthed ship, and

moving containers by said dedicated crane between said landing positions and said cargo container truck transporters concurrently with the movement of containers by said quay crane.

2. The method of claim 1 including the step of

providing said landing deck with openings surrounding said landing positions,

providing a worker deck disposed below and proximate to said landing deck, and

performing interbox connector installation and removal operations while containers are temporarily positioned on said platform.

3. The method of claim 1 including the step of independently moving said platform to each operational position of said quay crane on said dock as said quay crane traverses said dock to unload the length of a container ship.

4. The method of claim 1 including providing said platform with a slewing jib crane which functions as said dedicated crane.

5. The method of claim 1 including providing said platform with a bridge crane which functions as said dedicated crane.

6. The method of claim 1 including providing said platform with a straddle crane which functions as said dedicated crane.

7. A method for dockside buffer crane cargo container handling in combination with a quay crane located on a dock, the steps comprising

providing an independently movable elevated platform formed for independently traveling dockside and having a multiplicity of cargo container landing positions disposed on a landing deck portion thereof,

providing said platform with a dedicated crane engaged therewith and arranged to transfer containers between said landing deck and cargo container truck transporters located alongside or below said platform,

providing guides for landing cargo containers on said landing positions,

providing openings in said landing deck surrounding said landing positions,

providing a worker deck disposed below and proximate to said landing deck,

positioning said platform dockside under said quay crane,

moving containers by said quay crane between said landing positions and shipboard cells of a dockside berthed ship,

moving containers by said dedicated crane between said landing positions and said cargo container truck transporters concurrently with the movement of containers by said quay crane,

performing portions of said dedicated crane container handling by automated control,

performing interbox connector installation and removal operations through said openings in said landing deck by workers standing on said worker deck while containers are temporarily positioned on said platform, and

independently moving said platform to each operational position of said quay crane on said dock as said quay crane moves along said dock to unload the length of a container ship.