United States Patent

[11] **3,630,390**

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[21] Appl. No. **7,446**
[22] Filed **Feb. 2, 1970**
[45] Patented **Dec. 28, 1971**
[73] Assignee **said Tax, by said Franke**
[32] Priority **Feb. 16, 1970**
[33] **Germany**
[31] **P 19 06 212.5**

[54] **CONTAINER-LOADING CRANE ARRANGEMENT**
12 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **214/14,** 212/15
[51] **Int. Cl.** **B63b 27/12**
[50] **Field of Search** 214/14, 15; 212/15, 22, 11

[56] **References Cited**

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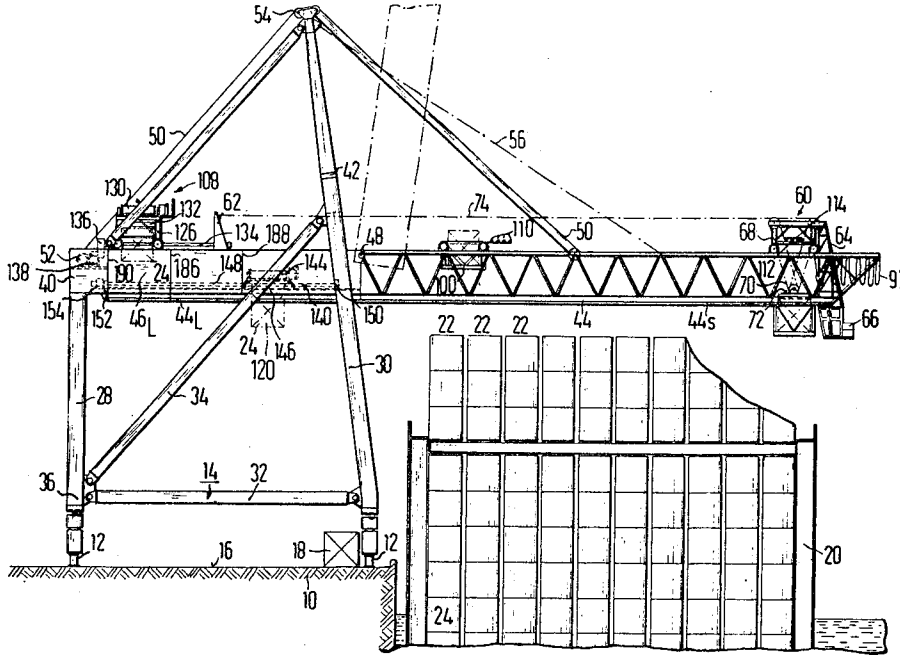
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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Frank E. Werner
Attorney—Kelman and Berman

ABSTRACT: A crane for loading and unloading a containership and for transferring the containers between the ship and land vehicles is equipped with normally stationary hoists on the portions of its beam which are above water and above land respectively. The containers lifted by one hoist and lowered by the other are transferred between the hoists on the platform of a carriage traveling horizontally on the crane beam and automatically controlled by limit switches. Two carriages and two hoists on the land side of the crane can normally be served adequately by one hoist on the sea side of the crane without interference if the two carriages travel on different levels, and the hoist on the land side cooperating with the higher carriage is farther removed from the hoist on the sea side than the other hoist on the land side.



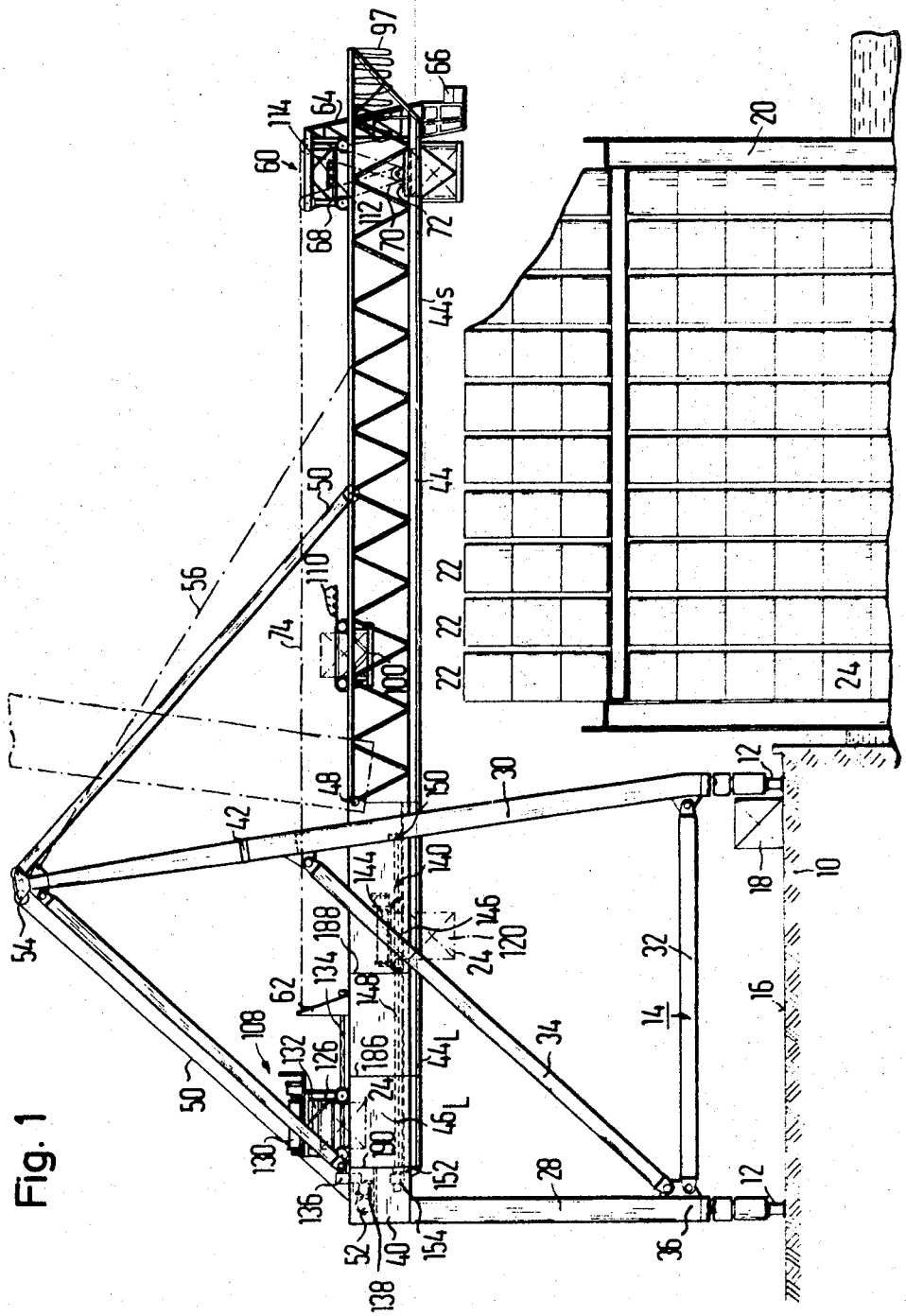


Fig. 1

Fig. 2

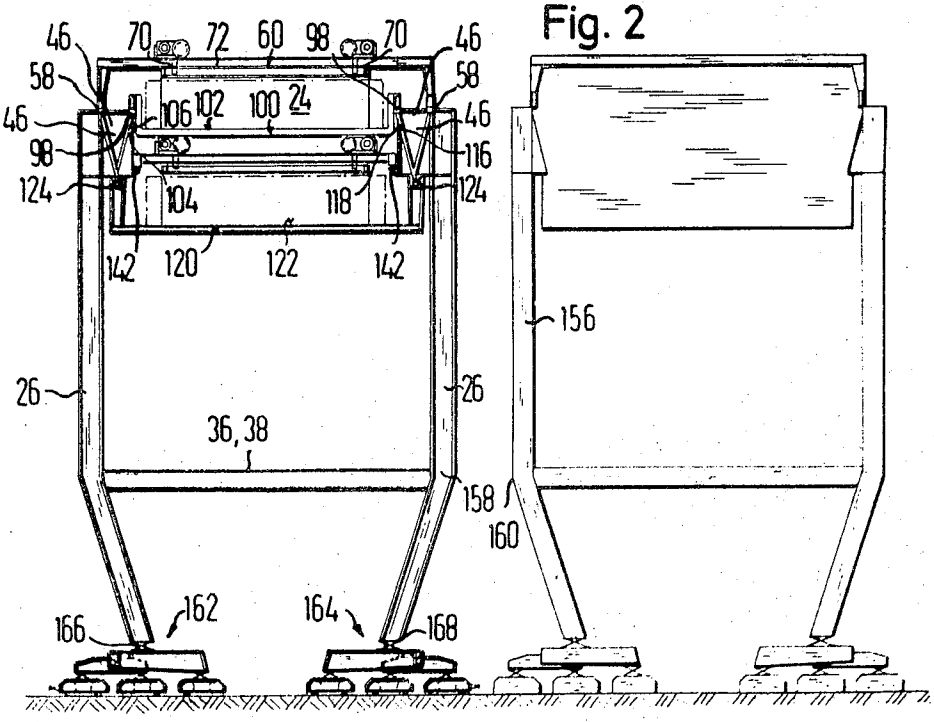

46
70
72
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98
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106
102
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116
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104
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36, 38
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Fig. 5

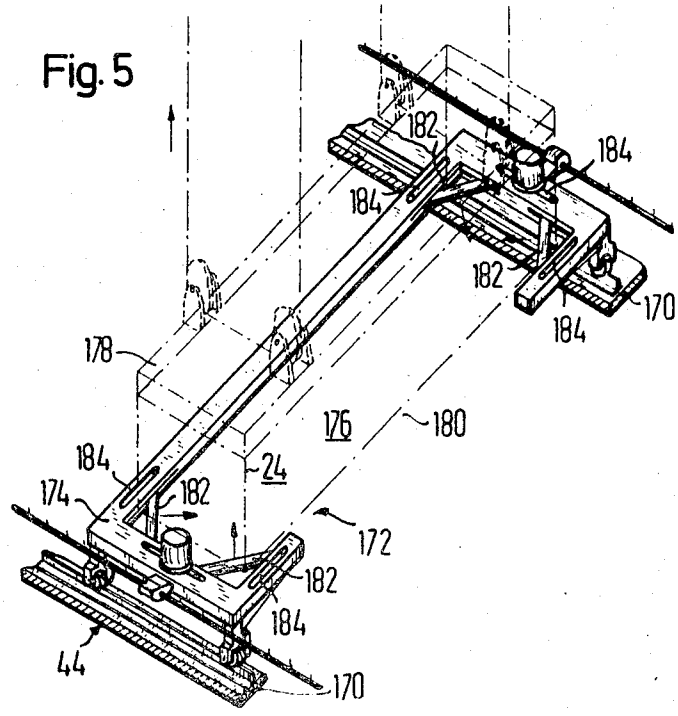

182
184
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170
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178
176
180
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24
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Fig. 3

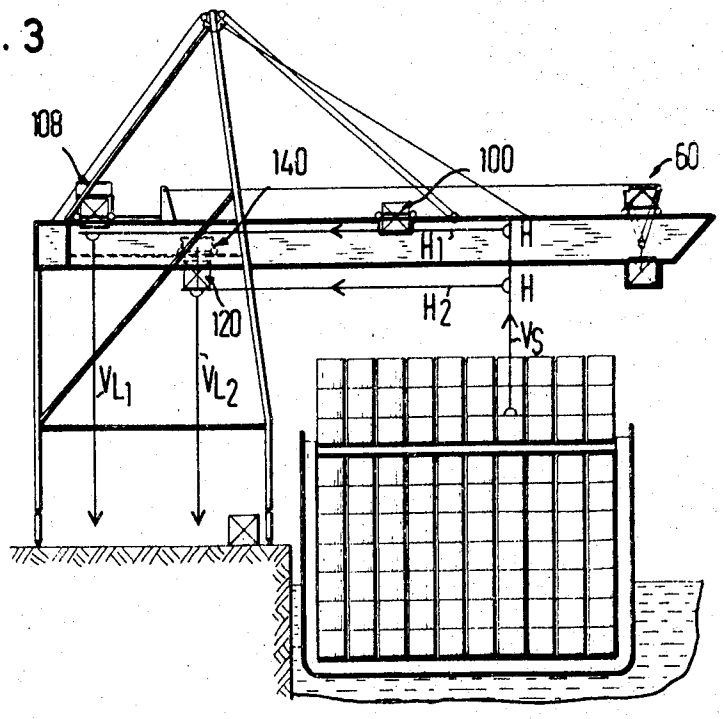

108
140
100
60
H1'
H
H2'
H
120
VS
VL1
VL2

Fig. 6

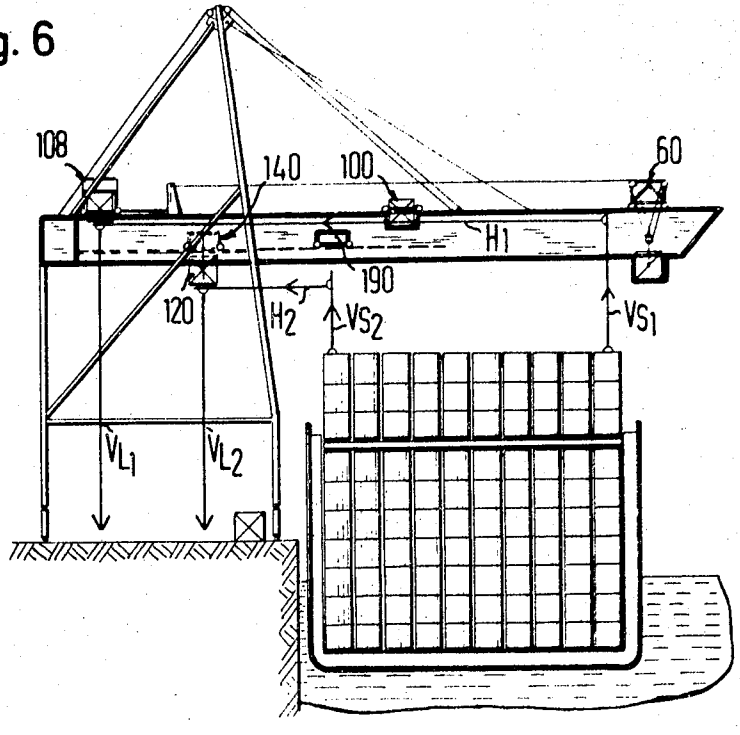

108
140
100
60
H1
190
120
H2
VS2
VS1
VL1
VL2

Fig. 4

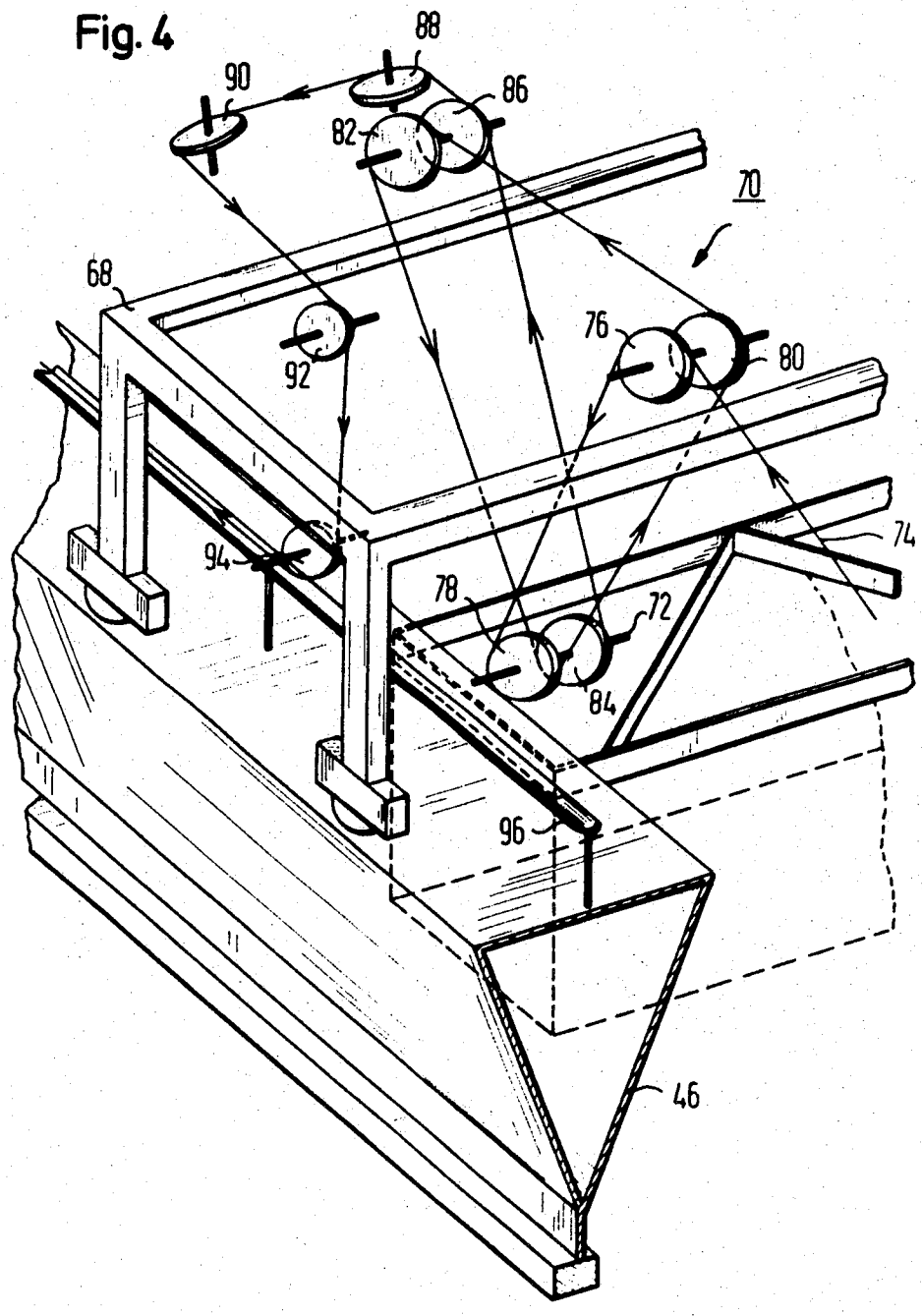
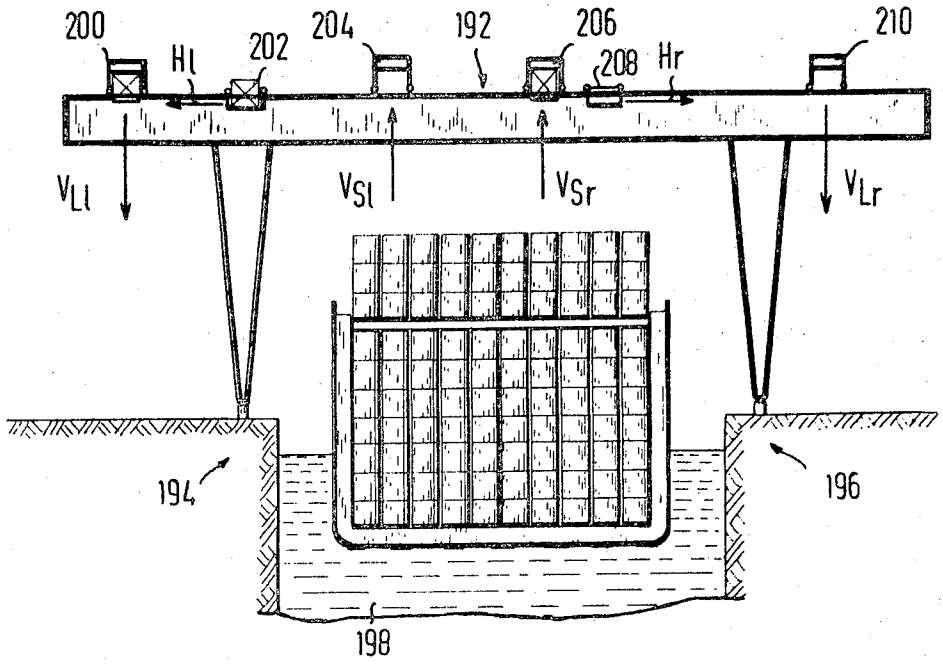


Fig. 7



CONTAINER-LOADING CRANE ARRANGEMENT

This invention relates to equipment for loading and unloading container ships, and particularly to a crane arrangement for transferring containers between waterborne vehicles and land vehicles.

Known cranes are equipped with a frame adapted to stand at the edge of a waterway and carrying a beam which extends substantially horizontally when in its operating condition in which a portion of the beam is above the waterway and another portion above land adjacent the waterway. Load-conveying apparatus on the beam lifts a container from a vehicle on the waterway, moves the container along the beam to the other portion of the beam, and thereafter lowers the container to a land vehicle. This invention is more particularly concerned with improvements of the load-conveying apparatus.

The capacity of known crane arrangements of the aforedescribed type is normally limited by the forces required for accelerating and decelerating the load and the associated, moving portions of the load-conveying apparatus. The known cranes can handle only one load at a time, and the number of containers combined in a single load is limited by the ability of the stationary crane structure to absorb the reaction of the load as its speed or direction of movement is changed.

The primary object of the invention is the provision of a crane arrangement of greatly increased operating capacity as compared to known cranes of comparable weight, size and cost.

A more specific object is the provision of a crane arrangement in which the heavy hoists do not move along the crane beam during most of the operating time of the apparatus.

With these objects and others in view, as will hereinafter become apparent, the invention provides a crane of the aforedescribed type with at least one normally stationary hoist and with a carriage which moves along the beam of the crane toward and away from the hoist. A container is transferred between the hoist and the carriage during its loading or unloading.

If only one such hoist is provided, it is mounted over the waterway, but two or more hoists are preferred, at least one, but preferably two being arranged on the portion of the beam which extends above land.

Other features, additional objects and many of the attendant advantages of this invention will become apparent from the following detailed description of preferred embodiments when considered in connection with the appended drawing in which:

FIG. 1 shows a container-loading crane arrangement of the invention in side elevation and partly in section;

FIG. 2 shows the arrangement in FIG. 1 in fragmentary front elevation;

FIG. 3 diagrammatically illustrates the operation of the arrangement of FIG. 1 in side elevation;

FIG. 4 is a perspective, partly diagrammatic view of a portion of the apparatus of FIG. 1;

FIG. 5 shows a modified element for the apparatus of FIG. 1 in a perspective top view;

FIG. 6 illustrates the operation of a modified crane arrangement in the manner of FIG. 3; and

FIG. 7 shows another crane arrangement of the invention in side elevation and partly in section.

Referring now to the drawing in detail, and initially to FIGS. 1 and 2, there is seen a pier 10 on which widely spaced rails 12 parallel to the edge of the pier support two cranes 14,156. The two cranes are identical, and the following description will be generally limited to the crane 14.

A traffic surface 16 between the rails 12 is equipped for supporting land vehicles 18 which may be trucks or railroad cars on several juxtaposed lanes of roadway and/or railroad tracks. A containership 20 is moored to the pier 10 and loaded with stacks 22 of rectangular containers 24. The illustrated containers are of quadratic cross section and elongated at right angles to the plane of FIG. 1 and have dimensions of several yards in all directions.

The crane 14 had two identical side frames 26 including an upright rear column 28 and a much higher front column 30. The columns are connected near their bottom ends by a horizontal, longitudinal frame member 32, and further by two diagonal struts 34. The two side frames 26 are connected by lower transverse members 36,38 on the level of the frame members 32. The tops of the rear columns 28 are transversely connected by a box section girder 40, and the front columns 30 by a transverse member 42 between the ends of the higher and lower struts 34.

The crane beam 44 has a fixed section 44_L which is entirely located above land, and a movable section 44_S, most of which extends over water in the operative position of the beam 44 shown in fully drawn lines. The beam 44 mainly consists of two spacedly juxtaposed, longitudinal girders 46, each girder having a longitudinal portion 46L in the beam section 44_L which is a box section, and a portion 46_S in the beam section 44_S which is a lattice girder. The girders 46 are fastened to the transverse girder 40 to form a hollow-shaped structure therewith, but are not otherwise transversely connected except at their free ends so as to define an unobstructed air space therebetween. The fixed girder portions 46_L each consist of three longitudinal parts connected by joints 186,188 to facilitate assembly.

The ends of two cables 50 are attached to the movable girder portions 46_S respectively and to a winch 52 mounted in the hollow interior of the transverse girder 40, and are trained over guide pulleys 54 at the top of the front columns 30. A cable 56 attached between each girder portion 46_S and the top of the corresponding front column 30 limits the downward movement of the beam section 44_S to a position in which both beam sections are horizontal and aligned. The winch 52 may raise the beam section 44_S to the position shown in chain-dotted lines.

Four pairs of load-bearing guide rails 58, 98, 124, 142 run along the beam 44, the members of each pair being secured to the two girders 46 respectively. The rails 58 mounted on the outer edges of the upper girder chords support a first traveling hoist 60 for movement between the free end of the movable beam section 44_S and buffers 62 which project upwardly from the upper beam chords of the beam section 44_L between the columns 28,30. A depending bracket 64 on the traveling hoist 60 carries an operator's cab 66 below the crane beam 44.

As is better seen in FIG. 4, the frame 68 of the hoist 60 is connected on each side by a pulley system 70 and a lifting cable 74 with a container lifting frame or spreader 72. Automatic coupling mechanisms at the four corners of the spreader, conventional in themselves and not shown, can attach the spreader to a container to be transported, the container being shown in phantom view in FIG. 4. The lifting cable 74 is trained in the pulley system 70 sequentially over a pulley 76 on the hoist frame 68, a pulley 78 on the spreader, two pulleys 80,82 on the frame, a pulley 84 on the spreader, and pulleys 86,88,90,92,94 on the frame which ultimately lead the cable into a trough 96 which extends from the front end of the beam 44 to the bumper 62 and prevents the end of the cable which is attached to the bumper, from sagging. The other end of the cable 74 is trained over a guide pulley at the front end of the beam 44 and one of the guide pulleys 54 to a motor-driven winch in the box girder 40 in a manner not illustrated in order not to crowd the drawing and analogous to the showing of the cable 50 and winch 52.

The control circuits of the crane are connected with the operator's cab 66 by a festooned cable 97 whose loops are suspended from one of the rails 58. The cable also provides power for the nonillustrated motor which permits the hoist 60 to be shifted on the rails 58.

The rails 98 at the inner edges of the upper girder chords support a self-propelled carriage 100 having a suspended platform 102 low enough to clear a container 24 raised to its highest position by the hoist 60 when the cable 74 is pulled in by the nonillustrated winch in the girder 40. Electric current for the nonillustrated drive motor of the carriage 100 is pro-

vided by a third rail 104 on the beam 44 and a contact shoe 106 on the carriage. The carriage may travel on the beam 44 from the first hoist 60 to a second traveling hoist 108 at the rear end of the fixed beam section 44_L. Its movements are controlled partly by a set of limit switches 110 arranged for sequential engagement with cams 112 on a bracket 114 of the first hoist 60, partly by a nonillustrated set of cooperating limit switches on the carriage 110 and the hoist 108 identical with the switches 110 and the cams 112, and partly be remote on-off control through a rail 116 insulated on the girder 46 and another contact shoe 118 on the carriage 100.

Another self-propelled carriage 120 travels on the rails 124 which are fastened to the lower chords of the girders 46, and has a platform 122 downwardly offset from the carriage 110 sufficiently to provide space for a container 24 on the platform 122 in all portions of the carriages. It is powered by electric current supplied in the same manner as to the carriage 100, but not shown in the drawing, and mainly controlled by limit switches as described above.

The rails 58 also support the traveling frame 126 of the second traveling hoist 108. The hoist is equipped with a motor-driven winch 130 from which a spreader 132 is suspended. When fully raised, the spreader 132 clears a container supported on the platform 102 of the carriage 100. The hoist 108 may be shifted on the beam section 44_L between the bumpers 62 and the transverse girder 40 by means of two horizontal spindles 134 threadedly engaging the frame 126, journaled in the bumpers and in bearings blocks 136, and driven by an electric motor 138 in the hollow girder 40.

A third traveling hoist 140 may move horizontally on the fourth set of short rails 142 attached to the upper chords of the girder portions 46_L by depending brackets. The hoist 140 is equipped with a motor-driven winch 144 for raising and lowering a spreader 146. The third hoist 140 may be shifted on the crane beam 44 between positions respectively adjacent the front columns 30 and the bumpers 62 by means of threaded spindles 148 journaled in bearing blocks 150,152 and operated by drive motors 154.

The winch motors of the hoists 108 and 140 are supplied with operating signals through nonillustrated festooned cables as shown for the drive motor of the hoist 60, and with power through third rails, not shown, as in the carriages 100,120. The motors which drive the undercarriages 162,164 of the two cranes 14,156 have not been shown, since they are conventional. The undercarriages of each crane are offset from the side frames 26 toward each other in such a manner that the cranes may be moved into abutting engagement of the opposite vertical faces 158,160 of respective side frames. The side frames are supported on the undercarriages 162,164 by means of edge bearings 166,168 as is known in itself.

The operation of the aforedescribed apparatus, as far as not obvious from the description of the structure, is diagrammatically indicated in FIG. 3 with reference to the unloading of the ship 20.

The first hoist 60 is positioned above a stack 22 of containers 24 which it is desired to land. During the short horizontal movement of the hoist into a position aligned with the intended vertical upward path V_S of the container, the vertical position of the spreader 72 remains unchanged, as is inherent in the reeving of the cable 74 seen in FIG. 4. The cable 74 then is alternatingly played out and retracted by the nonillustrated winch in the transverse girder 40 to lift the containers of the selected stack to a height sufficient to permit them to be transferred at one of the two transfer points H to the carriages 100 or 120 which enter the path V_S after a container has reached its topmost position.

The carriages transfer the containers in respective horizontal paths H_1,H_2 to the hoists 108,120 respectively whose positions are set in alignment along the downward paths V_{L1},V_{L2} with a string of land vehicles ready to receive the containers, the paths V_{L1},V_{L2} intersecting the paths H_1,H_2. As is evident from FIGS. 1 and 3, the path V_S is much shorter than the paths H_1,H_2, V_{L1},V_{L2} during most of the unloading of the ship so that the capacity of the illustrated crane 14 is practically six times that of an otherwise comparable crane on which a single hoist lifts containers from the ship, travels the length of the crane beam, and lowers the container to a land vehicle, thereafter to return to its starting position.

If for any reason, the time required for lifting containers out of the ship should be substantially more than half the travel time of the container in a horizontal path along the crane beam and thence downwardly to a land vehicle, a fourth hoist 190 may be associated with the first hoist 60 on the beam section 44_S as the two hoists 108,140 are arranged on the section 44_L so that two containers may be lifted independently from each other in the two vertical paths V_{S1},V_{S2}, travel along the beam in horizontal paths H_1,H_2 and downward in paths V_{L1},V_{L2}. As many as six containers may be handled simultaneously by the modified crane shown in FIG. 6 without interfering with each other.

The operator in the cab 66 may start and stop the operation of the crane and shift the several hoists into desired vertical paths, but the crane may normally be operated automatically by means of limit switches such as the switches 110 and cooperating cams to admit the carriages 100,120 into the vertical paths under the several hoists only until the associated spreaders have reached an adequate height, thereafter to position the carriages in alignment with the spreaders and to start a cycle of hoist operations while the carriages again move away.

Without intervention of the operator, a container 24 may thus be lifted by the hoist 60 from the ship 20 to a height sufficient to permit the carriage 100 to move under the container, whereupon the container is lowered until it rests on the platform 112 and the coupling mechanisms on the spreader 72 release the container. While the spreader 72 is briefly lifted, the carriage 100 moves inland, and the spreader 72 is thereafter lowered to the ship 20 for engagement with the next container 24 in the same stack 22.

When the spreader 132 is above the path of the carriage 100, the carriage moves below the hoist 108, the spreader 132 is lowered for coupling to the container 24 on the platform 112. The container is briefly lifted to permit the carriage 100 to move back toward the hoist 60 which in the meantime has transferred another container to the carriage 120. When the carriage 100 is out of the way, the spreader 132 with the container suspended therefrom is lowered to deposit the container on a land vehicle.

Containers taken from the ship 20 are thus conveyed alternatingly to two strings of vehicles aligned with the hoists 108,140 respectively. The operation of the crane shown in FIG. 6 will be obvious without detailed description, and the reversal of the sequence of operations during the loading of a containership is equally evident.

In the event of partial equipment failure, or for transferring only a single container from the ship 20 to a land vehicle, the hoist 60 may travel on the rails 58 from the position shown in FIG. 1 to the buffer 62 while carrying a lifted container or other load, and may then lower the load to a land-based vehicle.

The modified carriage illustrated in FIG. 5 may be positioned under a hoist even before the container intended to be transferred to the carriage has reached a position above the carriage level.

The modified carriage 172 travels on rails 170*a*,170*b* of the beam which may be identical with the aforementioned rails 124,142. It has a horizontal frame 174 about a rectangular opening 176 of a size sufficient to pass the container 24 which is shown in FIG. 5 in phantom view together with the associated spreader 178. The frame 174 has the approximate C-shape of a rectangle in which one of the long sides has a wide gap 180.

The ends of locking bars 182 are received in horizontal slots of the frame 174 and are guided by pins in vertical slots 184 in such a manner that the bars 182 may be moved by motor-driven rack-and-pinion arrangements concealed in the frame

174 between the illustrated position and an inactive position in which the bars 182 are completely withdrawn into the frame 174 to permit passage of the container while supporting the four corners of the container when a container is lowered toward the frame 174 while the bars 182 are in the illustrated operating positions.

With the bars 182 retracted, the carriage 172 may thus be moved into the upward path of a container while the lifting cables on the spreader 178 enter the opening 176 through the gap 180. After the container has passed the opening, the locking bars 182 retain it when it is lowered thereafter to the supporting plane defined by the bars 182.

FIG. 7 shows a bridge crane 192 of the invention extending between the two banks 194,196 of a canal 198 for unloading or loading a container ship floating in the canal. The crane carries four hoists 200, 204, 206, 210 whose position along the bridge of the crane may be adjusted, but which normally stand still during operation of the crane, and two carriages 202,208 having respective platforms for transferring containers between the hoists 204,200 and 206,210 respectively, the several hoists and carriages being substantially identical with corresponding devices shown in FIG. 1.

During unloading of the ship, containers may be moved by the illustrated hoists and carriages in each of two vertical upward paths V_{S1},V_{Sr}, two horizontal paths H_l,H_r along the crane bridge, and two downward vertical paths V_{L1},V_{Lr} to vehicles on the left and right banks 194,196 respectively, the crane may operate as automatically as that described above with reference to FIGS. 1 to 4 by means of limit switches and cooperating cams.

We claim:

1. In a container-loading crane arrangement having a vertically extending frame adapted to stand at the edge of a waterway, a beam mounted on said frame and extending substantially horizontally when in an operating condition thereof, a portion of said beam in said condition extending above said waterway and another portion of the beam extending above land adjacent said waterway, and load-conveying means on said beam for lifting a container from a waterborne vehicle on said waterway, moving said container along said beam to said other portion of the same, and thereafter lowering said container to a land vehicle, the improvement in the load-conveying means which comprises:
   a. a first hoist and a second hoist on said portions of the beam respectively;
   b. a first carriage movable along said beam between said hoists; and
   c. transferring means for transferring a container between each of said hoists and said carriage.

2. In an arrangement as set forth in claim 1, guide means for guiding said first carriage in a horizontally extending path on said beam, said hoists including means for moving said container in respective vertical paths intersecting said horizontally extending path.

3. In an arrangement as set forth in claim 1, a third hoist on said other portion of said beam, a second carriage movable on said beam between said first hoist and said third hoist, and transferring means for transferring a container between said second carriage and said first and third hoists respectively.

4. In an arrangement as set forth in claim 3, guide means on said beam for guiding said carriages in respective, vertically offset paths during movement thereof on said beam, said second carriage moving in a path lower than the path of said first carriage, and said second hoist being farther from said first hoist than said third hoist, said carriages each defining a plane of support and being adapted to receive said container on said plane.

5. In an arrangement as set forth in claim 4, each of said hoists including a winch, a cable member secured to said winch for being paid out and retracted when said winch operates, and coupling means for coupling said cable member to a container, said winch, cable member and coupling means jointly constituting one of said transferring means.

6. In an arrangement as set forth in claim 1, said carriage including a horizontally extending platform adapted to support said container thereon.

7. In an arrangement as set forth in claim 1, electrically operated control means for controlling movement of said carriage along said beam, said control means including a limit switch member and a limit switch operating member, one of the members of said control means being mounted on said carriage and the other member on said hoist for engagement with said one member.

8. In a container-loading crane arrangement having a vertically extending frame adapted to stand at the edge of a waterway, a beam mounted on said frame and extending substantially horizontally when in an operating condition thereof, a portion of said beam in said condition extending above said waterway and another portion of the beam extending above land adjacent said waterway, and load-conveying means on said beam for lifting a container from a waterborne vehicle on said waterway, moving said container along said beam to said other portion of the same, and thereafter lowering said container to a land vehicle, the improvement in the load-conveying means which comprises:
   a. a first hoist on one of said portions of the beam;
   b. a first carriage movable along said beam toward and away from said hoist, said carriage including
      1. a frame formed with an opening dimensioned for vertical passage of a container through said frame, and
      2. a plurality of blocking members mounted on said frame for movement into and out of said opening, said blocking members when in said opening preventing passage of said container and defining a supporting plane for the same; and
   c. transferring means for transferring said container between said hoist and said carriage.

9. In an arrangement as set forth in claim 8, said hoist including a vertically extending lifting cable, and said frame being formed with a gap communicating with said opening for movement of said cable into and out of said opening during said movement of said carriage.

10. In a container-loading crane arrangement having a vertically extending frame adapted to stand at the edge of a waterway, a beam mounted on said frame and extending substantially horizontally when in an operating condition thereof, a portion of said beam in said condition extending above said waterway and another portion of the beam extending above land adjacent said waterway, and load-conveying means on said beam for lifting a container from a waterborne vehicle on said waterway, moving said container along said beam to said other portion of the same, and thereafter lowering said container to a land vehicle, the improvement in the load-conveying means which comprises:
   a. a first hoist on one of said portions of the beam;
   b. a first carriage movable along said beam toward and away from said hoist;
   c. transferring means for transferring a container between said hoist and said carriage; and
   d. adjusting means for adjusting the position of said hoist along said beam, said adjusting means including
      1. a threaded spindle having an axis and threadedly engaging said hoist, and
      2. drive means for rotating said spindle about said axis thereof.

11. In a container-loading crane arrangement having a vertically extending frame adapted to stand at the edge of a waterway, a beam mounted on said frame and extending substantially horizontally when in an operating condition thereof, a portion of said beam in said condition extending above said waterway and another portion of the beam extending above land adjacent said waterway, and load-conveying means on said beam for lifting a container from a waterborne vehicle on said waterway, moving said container along said beam to said other portion of the same, and thereafter lowering said container to a land vehicle, the improvement in the load-conveying means which comprises:

a. a first hoist on one of said portions of the beam, said hoist including

1. a hoisting cable member, and

2. coupling means secured to said cable member for engagement with a container;

b. a first carriage movable along said beam in a horizontally extending path,

1. a portion of said cable member being elongated in the direction of said path and longitudinally coextensive with said path; and

c. supporting means on said beam supporting said portion of the cable member substantially over the entire length thereof for preventing sagging of said portion.

12. In an arrangement as set forth in claim 11, said supporting means including an elongated, upwardly open trough member.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,630,390 Dated December 18, 1971

Inventor(s) Hans Tax and Rüdiger Franke

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the title page, correct line 32 to read:

/32/ Priority Feb. 7, 1969

Signed and sealed this 13th day of June 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents