Nov. 13, 1962 R. L. BEVARD 3,063,572

COUNTERBALANCED CARGO HANDLING APPARATUS

Filed Dec. 2, 1960 3 Sheets-Sheet 1

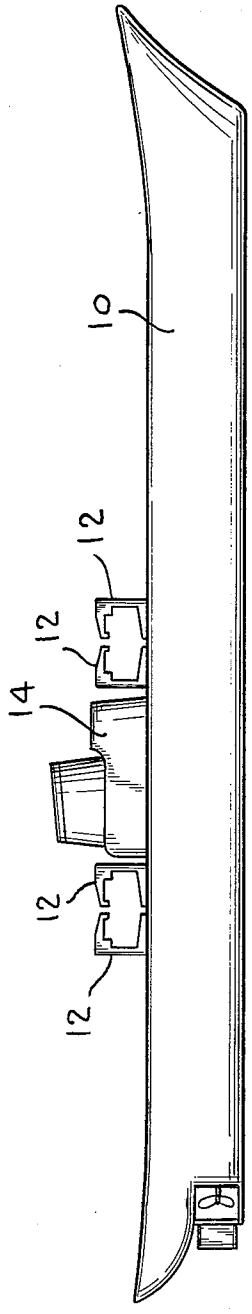


FIG. 1

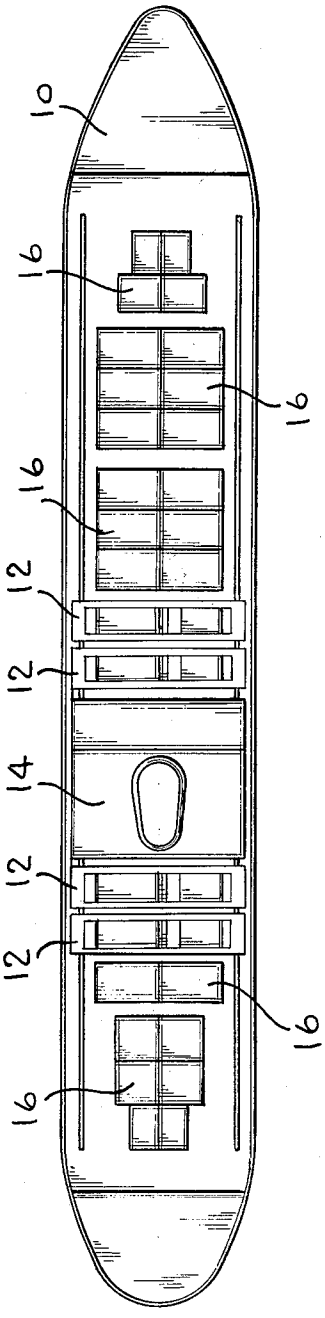


FIG. 2

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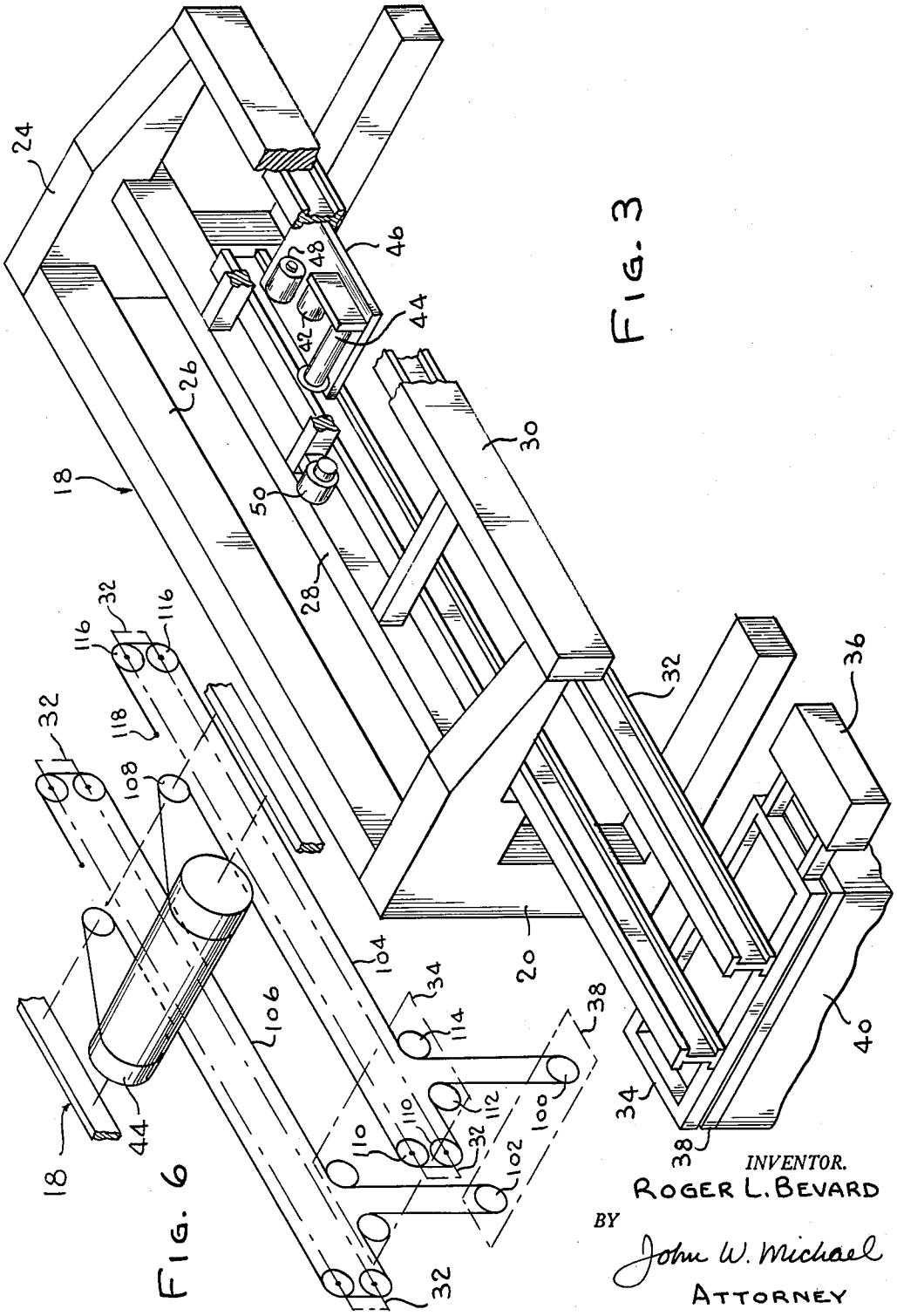


FIG. 3

FIG. 6

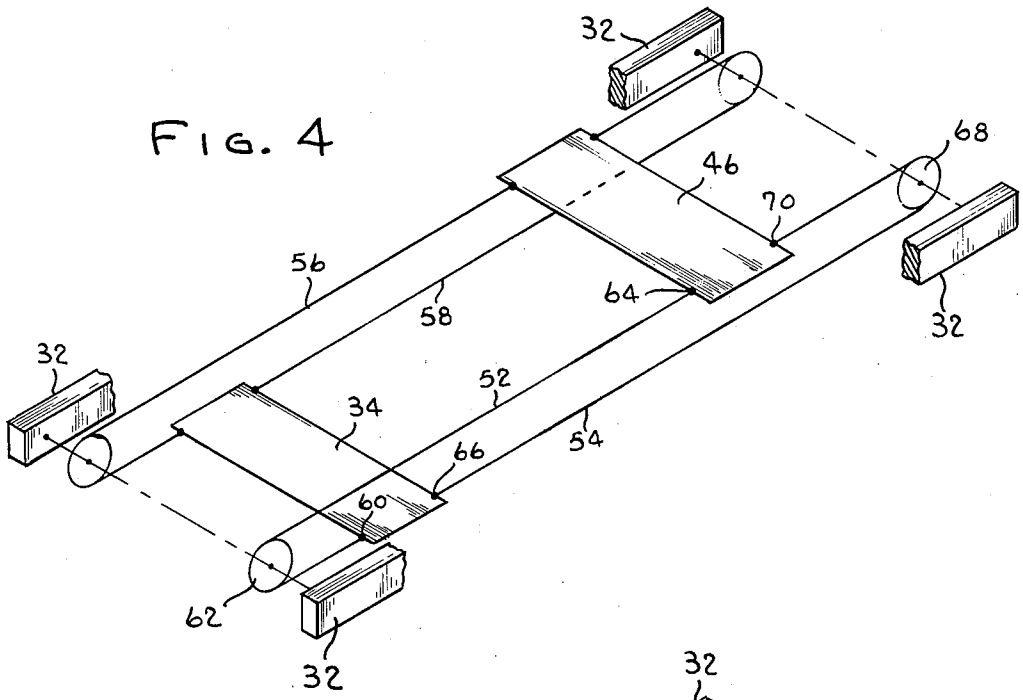
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FIG. 4



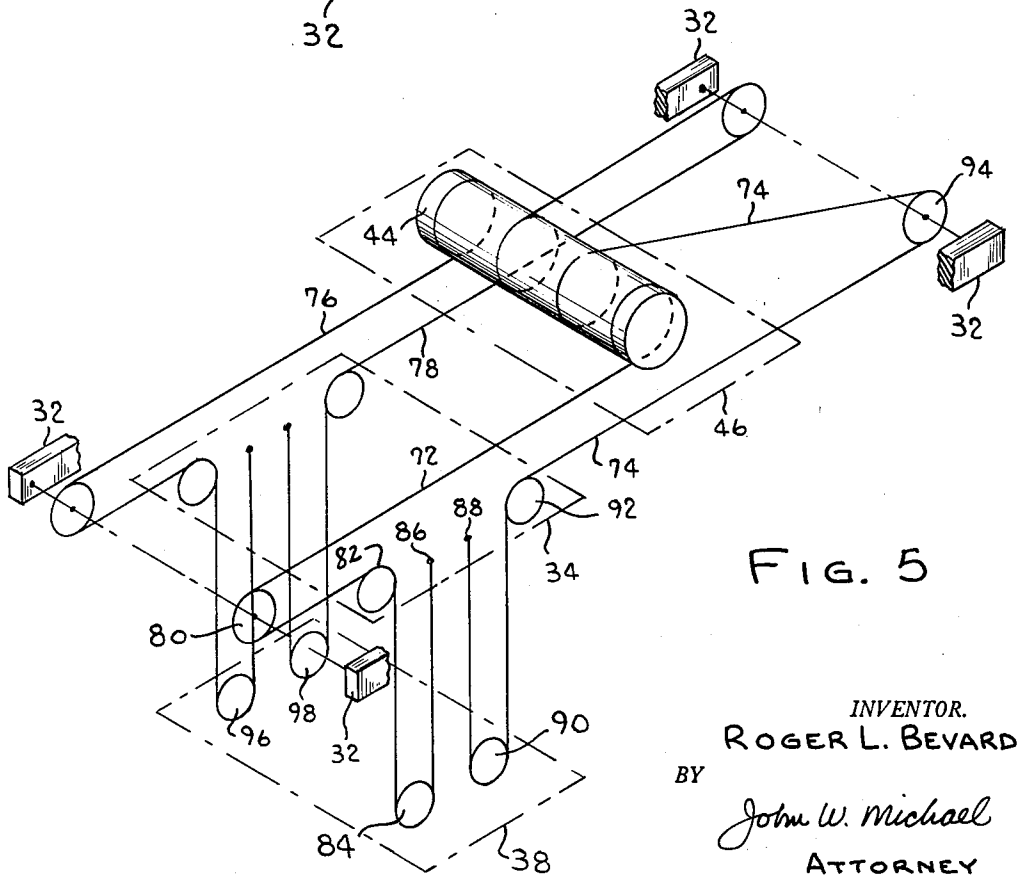


FIG. 5

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3,063,572 COUNTERBALANCED CARGO HANDLING APPARATUS

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Filed Dec. 2, 1960, Ser. No. 73,294
3 Claims. (Cl. 212—15)

This invention relates to cargo handling apparatus and particularly to counterbalanced apparatus for loading and unloading containerized cargo from a ship.

As explained in my copending application Serial No. 44,607, filed July 22, 1960, the acceptance of containerized cargo by the shipping industry has been very widespread in recent years. The use of larger, heavier containers creates problems not heretofore present in this industry. Various arrangements specifically designed to meet these problems have been described in my copending application identified above. The subject matter of this application provides certain improvements over those arrangements shown in my copending application and differs from such application primarily in that the counterweight trolley herein is mounted on the boom instead of on the gantry as was the case in the previous application.

The principal object of this invention is to provide a counterbalanced cargo handling apparatus having a simplified hoist and haulage reeving arrangement.

Another object is to provide an arrangement having more efficient hoist and haulage drives requiring less power for either drive.

Another object is to provide an arrangement wherein the racking of the booms will not cause movement of the load trolley on the boom but, instead, relates load trolley movement only to movement of the counterweight trolley.

The several objects of this invention are attained by apparatus which includes a gantry frame mounted on a ship and having a boom slidably mounted thereon adapted for athwartship movement outboard over the side of the ship. A counterweight trolley mounted for athwartship movement on the boom is a unique feature of this invention. A load trolley having a container carrying spreader supported therefrom is mounted on the boom for athwartship travel thereon. The load trolley is moved athwartship on the boom by a haulage means which includes pairs of constant length haulage cables and a counterweight trolley mounted for athwartship movement on the boom. The haulage cables are dead-ended on the counterweight trolley, reeved over sheaves on opposite ends of the boom, and then dead-ended on the load trolley to provide a very simple and efficient haulage reeving arrangement. With this arrangement, athwartship movement of the counterweight trolley on the boom will move the load trolley athwartship on the boom in the opposite direction from that of the counterweight trolley. No movement of the load trolley is caused by the racking of the boom, since both the load trolley and counterweight trolley are mounted on the boom.

The hoist machinery can be mounted either on the counterweight trolley or on the gantry. With the hoist on the counterweight trolley, the hoist reeving runs from the trolley to opposite ends of the boom, to load trolley sheaves, and then to spreader sheaves and then back to the load trolley. This results in a very simple hoist reeving arrangement to provide a more efficient hoist drive.

The arrangement whereby the hoist machinery is mounted on the gantry results in a somewhat more complex reeving arrangement but does serve to remove some of the weight from the boom which may be desirable in some applications.

Other objects and advantages will be pointed out in, or be apparent from, the specification and claims, as will obvious modifications of the two embodiments shown in the drawings, in which:

FIGS. 1 and 2 are side elevation and top plan views, respectively, of a ship equipped with cargo handling apparatus constructed in accordance with this invention;

FIG. 3 is a partially schematic perspective view of a single cargo handling unit embodying the invention;

FIGS. 4 and 5 are simplified reeving diagrams showing the haulage and hoist reeving, respectively, for the unit shown in FIG. 3; and

FIG. 6 is a modified hoist reeving diagram wherein the hoist machinery is mounted on the gantry as opposed to the counterweight trolley.

As shown in FIGS. 1 and 2, an average size freighter **10** is equipped with a total of from two to four units **12** located fore and aft of the ship's superstructure **14** as shown. A single unit of **C** frame construction, such as that shown in FIG. 3, is designed for fore and aft movement on the ship's deck between hatches **16**. A single **C**-frame unit (FIG. 3) is designed for handling containers of from 17 to 24 feet in length and is rated at from 20 to 25 long-ton capacity. By using two units facing each other and working in tandem, large bulky objects such as long tanks or pipe for deck cargo may be handled. Hoisting capacity is doubled. For handling maximum length containers from 35 to 40 feet long, a closed sided gantry of symmetrical design (not shown) may be employed.

Referring now to units **12** in detail, FIG. 3 shows one unit having a gantry frame **18**, comprising a pair of **C**-shaped end members **20, 24** interconnected by cross supports **26, 28** and **30** as shown. Gantry frame **18** is mounted for fore and aft movement on the deck of freighter **10** by pairs of trucks (not shown) mounted on the bottom of **C**-members **20, 24**.

A boom **32** is slidably supported on the underside of the upper portion of gantry frame **18** for athwartship travel outboard on either side of the ship. An improved mounting arrangement for the boom is described in detail in my copending application Serial No. 44,607.

A load trolley **34** having an operator's cab **36** and a container carrying spreader **38** supported therefrom is mounted on boom **32** for athwartship movement along the boom. Spreader frame **38** is adapted for detachable connection to a cargo container **40** and can be hoisted and lowered to and from trolley **34** by a hoist cable arrangement (FIG. 5) to be described hereinafter. The detailed construction and operation of the container carrying spreader **38** is described in copending application Serial No. 44,607.

A hoist motor **42** and drum **44** for raising and lowering spreader **38** are mounted on a counterweight trolley **46** which in turn is mounted for athwartship travel on boom **32**. Counterweight trolley **46** is moved athwartship on the boom by means of a rack and pinion (not shown) driven by a drive motor **48** mounted on the counterweight trolley. The mounting of the hoist motor and drum on the counterweight trolley and the mounting of the counterweight trolley for athwartship movement on the boom greatly simplifies the hoist and haulage reeving and provides a better counterbalance for the load. However, where the situation requires the hoist machinery can be mounted on the gantry frame (FIG. 6) as described hereinafter.

Boom **32** is racked on gantry by a drive motor **50** mounted on the gantry and the entire unit can be moved fore and aft on the deck of the ship on the gantry trucks by any suitable drive means (not shown) mounted on either the gantry or the deck of the ship.

The haulage reeving arrangement for moving load

trolley 34 along the boom is shown on FIG. 4. Referring to FIG. 4, it is seen that load trolley 34 is moved athwartship along boom 32 by pairs of identically reeved haulage cables 52, 54 and 56, 58. Since each pair of haulage cables is reeved in an identical manner, only one such pair will be described. Cable 52 is dead-ended on load trolley 34 at a point 60, reeved over a sheave 62 at the left hand end of the boom and then back to the counterweight trolley 46 where it is dead-ended at a point 64. Cable 54 is dead-ended on load trolley 34 at a point 66, reeved over a sheave 68 at the right hand end of the boom and then back to the counterweight trolley 46 where it is dead-ended at a point 70. As stated previously, cables 56 and 58 on the other leg of the boom are reeved in an identical manner.

From the foregoing, it is seen that when boom 32 is racked on the gantry to its desired operating position by means of drive unit 50 (with counterweight trolley stationary) load trolley 34 will remain stationary on the boom. Once boom 32 has been positioned as desired, load trolley 34 is moved thereon for loading and unloading cargo by driving counterweight trolley athwartship on the boom by means of drive 48. For example, assume that with the boom extended it is desired to move the load trolley to the right on the boom (as viewed in FIG. 4) to unload a container from the ship's hold. This is accomplished by driving counterweight trolley 46 to the left by means of drive motor 48. When trolley 46 is thus driven, cables 54 and 58 will pull load trolley 34 to the right to the proper position for lowering the spreader frame 38 into the hold.

After a container is hoisted from the hold, the load trolley 34 is returned to the left end of the boom for unloading the container by driving counterweight trolley back to the right. This movement is caused by cables 52, 56 which pull the load trolley to the left. Thus, it is seen that as a load is moved athwartship from the center line of the ship in one direction, counterweight trolley 46 (with hoist and drive machinery 42, 44 and 48 mounted thereon) will move athwartship in the opposite direction to at least partially counterbalance the load and thus reduce the tendency of the ship to list.

Referring now to the simplified hoist reeving diagram shown in FIG. 5, container carrying spreader 38 (FIG. 3) is supported from load trolley 34 by four spreader frame sheaves 84, 90, 96, 98 mounted on the spreader frame. The spreader sheaves are supported by hoist cables 72, 74, 76, 78, respectively, which are reeved from hoist drum 44 on the counterweight trolley 46 to points on load trolley 34 where the cables are dead-ended.

Pairs of hoist cables 72, 74 and 76, 78 are reeved from the hoist drum on the counterweight trolley to the load trolley in an almost identical manner and thus the reeving for only one pair of cables will be described. Starting at hoist drum 44 on counterweight trolley 46, cable 72 is reeved over a sheave 80 at the left hand end of the boom, a sheave 82 on the load trolley, a sheave 84 on the spreader frame and then back to the load trolley, where it is dead-ended at a point 86. Cable 74 is reeved from the hoist drum on the counterweight trolley to a sheave 94 on the right hand end of boom 18, then to a sheave 92 on the load trolley, a sheave 90 on the spreader 38 and then back to the load trolley where it is dead-ended at a point 88.

With the foregoing arrangement (FIG. 5) it will be apparent that clockwise rotation of hoist drum 44 will cause spreader 38 to be lowered from the load trolley while counterclockwise rotation of the drum will raise the spreader. It is noted that with the haulage reeving arrangement (FIG. 4) previously described, load trolley 34 will be moved athwartship on the boom 32 when counterweight trolley 46 is driven athwartship on the boom. By reeving the hoist cables 72, 74 and 76, 78 from the hoist drum on the counterweight trolley in opposite directions to either end of the boom, and then back to the load trolley, such hoist cables will always remain of constant length (and thus not either raise or lower the spreader) when the counterweight trolley is moved to drive the load trolley athwartship on the boom.

It will also be apparent from the foregoing description of the hoist reeving arrangement that due to its relative simplicity, the hoist drive means will be more efficient and thus require less power to raise and lower a load than in previous counterbalanced arrangements.

Reference is now made to FIG. 6 which shows a modified hoist reeving diagram wherein the hoist machinery is mounted on the gantry 18 as opposed to the counterweight trolley. In this embodiment spreader frame 38 is supported from load trolley 34 by a pair of spreader frame sheaves 100, 102 mounted on the spreader. The spreader sheaves 100, 102 are supported by hoist cables 104 and 106, respectively, which are reeved from hoist drum 44 on gantry 18, to spreader sheaves 100, 102 and then back to points on the gantry where the cables are dead-ended.

Cables 104 and 106 are reeved from the hoist drum to the spreader sheaves and then back to the gantry in an almost identical manner and thus the reeving for only one cable will be described. Starting at drum 44 on gantry 18, cable 104 is reeved over a sheave 108 on the gantry and then back to a pair of sheaves 110, 110 at the left hand end of boom 32, to a sheave 112 on the load trolley, sheave 100 on the spreader, a sheave 114 on the load trolley, a pair of sheaves 116, 116 on the right hand end of the boom, and then back to the gantry where cable 104 is dead-ended at a point 118. This arrangement is somewhat more complex than that shown in FIG. 5 but does serve to remove the weight of the hoist machinery from the boom which may be desirable in some applications.

Although but two embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. Cargo handling apparatus for a ship comprising:
a gantry frame mounted on the ship;
a boom means mounted on said gantry for athwartship movement thereon;
boom drive means for moving said boom means athwartship on said gantry;
a load trolley mounted on said boom means for athwartship travel thereon;
a load carrying means supported from said load trolley and adapted for vertical movement to and from said load trolley;
hoist means for raising and lowering said load carrying means;
counterweight means adapted to counterbalance said load trolley as said load trolley is moved athwartship along said boom means, said counterweight means including a counterweight trolley mounted on said boom means and adapted for athwartship movement thereon;
counterweight trolley drive means for moving said counterweight trolley athwartship on said boom means, said counterweight trolley drive means including a counterweight trolley drive motor mounted on said counterweight trolley in driving engagement with said boom means; and
haulage means for moving said load trolley athwartship along said boom means, said haulage means including a pair of haulage cables dead-ended on said load trolley and then reeved around sheaves mounted at opposite ends of said boom means and then dead-ended on said counterweight trolley so that when said counterweight trolley is driven along said boom

means in one direction by said counterweight trolley drive means said load trolley will be moved in the opposite direction along said boom means.

2. Cargo handling apparatus according to claim 1 in which said hoist means includes a hoist drum mounted on said counterweight trolley and a pair of hoist cables reeved from said drum to sheaves on opposite ends of said boom means, then to sheaves on said load trolley, then to sheaves on said load carrying means and then back to said load trolley where said cables are dead-ended.

3. Cargo handling apparatus according to claim 1 in which said hoist means includes a hoist drum mounted on said gantry frame and a hoist cable wound on said

hoist drum, said hoist cable reeved over a sheave on said gantry, a sheave on one end of said boom means, a sheave on said load trolley, a sheave on said load carrying means, a second sheave on said load trolley, a sheave on the other end of said boom means, and then dead-ended on said gantry frame.

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