July 2, 1963 R. LANGFELDT 3,095,976

CARGO HANDLING APPARATUS

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Fig.1
(PRIOR ART)

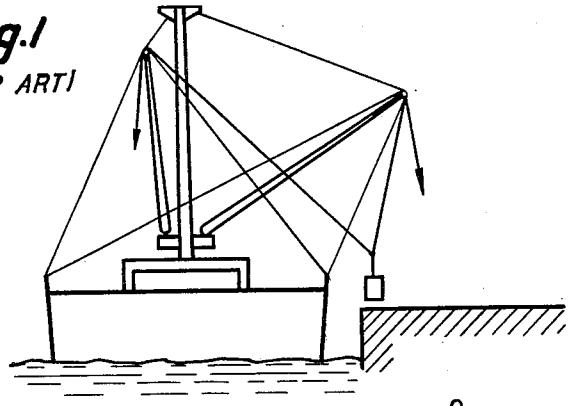


Fig.2
(PRIOR ART)

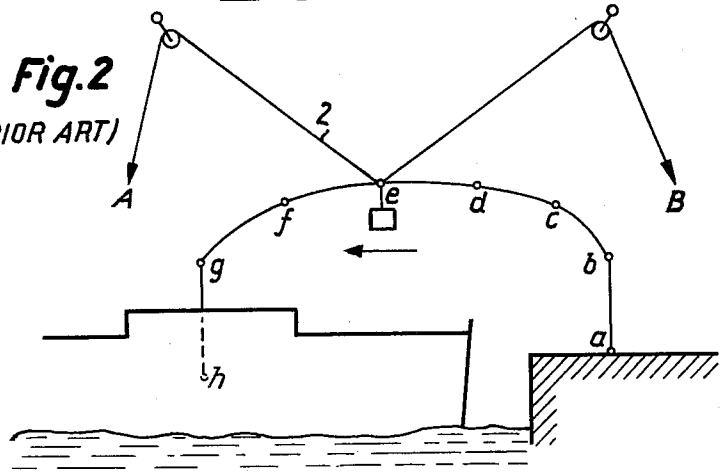
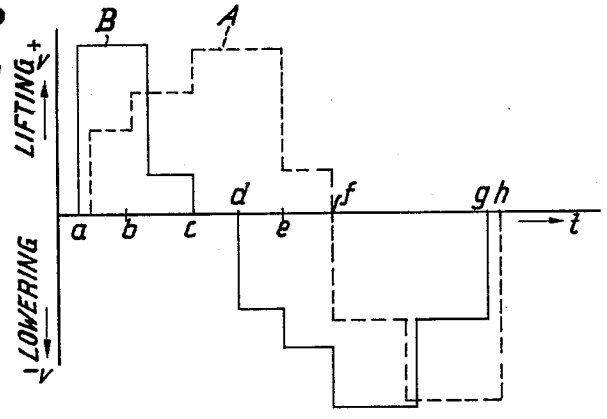


Fig.3
(PRIOR ART)



CARGO HANDLING APPARATUS

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Fig. 4

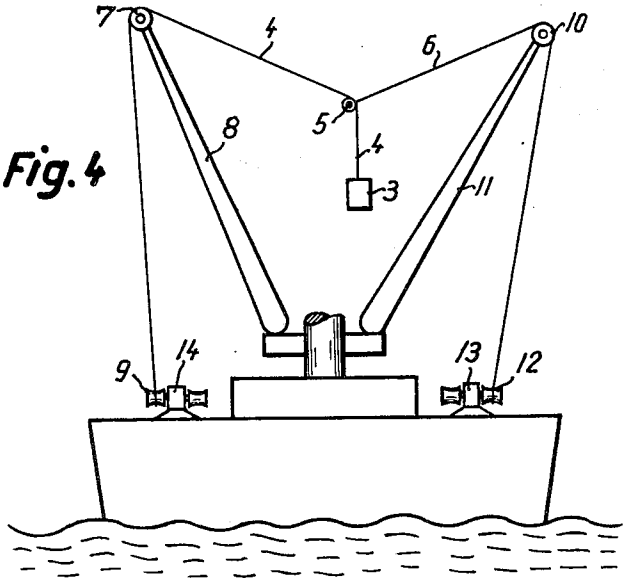


Fig. 5

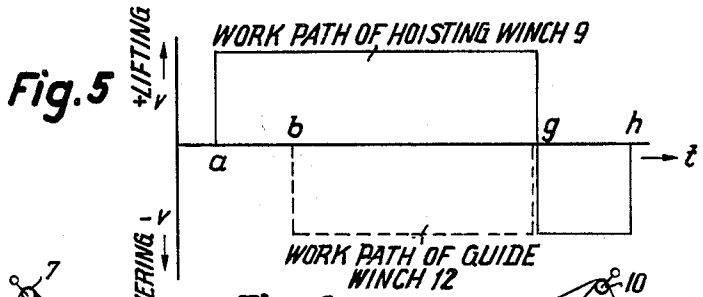
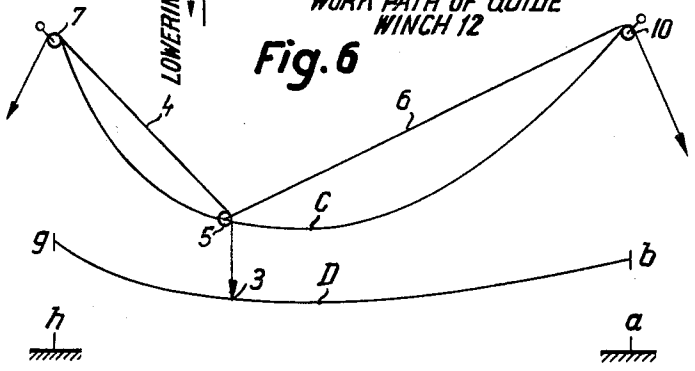


Fig. 6

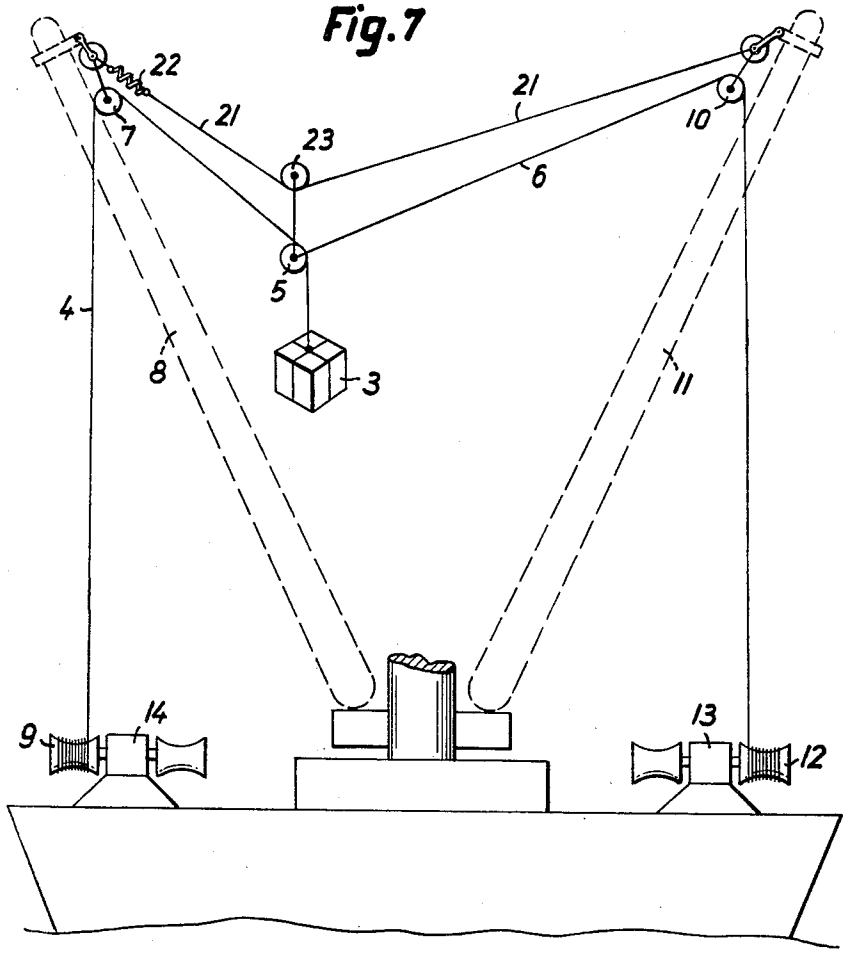


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Fig. 7



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CARGO HANDLING APPARATUS

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Claims priority, application Germany Mar. 18, 1959
5 Claims. (Cl. 212—3)

The present invention relates to improved apparatus for handling bulky or heavy articles or material, and is particularly suited for loading and unloading the cargo of merchant ships.

When cargo is to be loaded or unloaded with cargo handling apparatus which comprises two loading booms, one of the booms is positioned above the loading hatch, while the other loading boom is positioned above the loading dock. Each boom is maintained in this position horizontally by means of two guide ropes or guys and supported vertically by means of a hoisting rope. From the top of each loading boom, a rope leads to the loading hook and is secured to the latter. From the loading hook, each rope travels over a block at the top of the loading boom and over a block at the base to the drum of a suitable winch.

This type of prior art loading arrangement is illustrated diagrammatically in FIGURE 1 of the drawing. In FIGURE 2 of the drawing, the path followed by the load that is handled with this prior art cargo handling apparatus is divided into stages *a* to *h*; and FIGURE 3 shows the speed diagram of the two winch drives. The diagram of hoisting winch B is shown in solid lines, while the diagram of transfer winch A is represented in dotted lines.

Referring now to FIGURE 2, hoisting winch B is adapted to lift the load from *a* to *b*, while transfer winch A, which is actuated subsequently, takes up rope 2 with increasing speed in order to keep it taut. From point *b* onward, the transfer of the load commences. Transfer winch A runs now even faster, while hoisting winch *b* runs much slower in the direction of lift. From *c* to *d*, hoisting winch B is idle, and transfer winch A reaches its highest speed. From *d* onward, hoisting winch B operates in the direction of lowering; and transfer winch A, although only slowly from point *e* onward, still operates in the direction of lift. From *f* onward, both winches run in the direction of lowering, but at different speeds, until the load has reached *g*. From *g* to *h*, transfer winch A operates alone to lower the load into the loading hatch. When the empty hook is returned, or when cargo is transferred in the opposite direction, the two winches are operated in the reverse manner from the procedure just outlined.

During the cargo handling operation, the load on the two winches reaches at times the magnitude of the load that is being transferred. In the case where the cargo handling apparatus is not operated efficiently, the pull on the ropes can become larger than that which corresponds to the weight of the load. A further drawback of this prior art arrangement resides in the fact that, due to the complex procedure of this type of cargo handling operation, it is necessary to have one operator attend each of the two winches.

The cargo handling apparatus of this invention is particularly characterized by an arrangement wherein the hoisting rope is secured to the loading hook, while the guide rope is provided with a loose sheave at its free end over which the hoisting rope travels. In accordance with one embodiment of the present invention, each rope is connected to a winch, the winch connected to the hoisting rope being designed to supply the power required for raising and lowering the load, while the winch connected to the guide rope is adapted to the power requirements for transferring the load and for returning the empty loading hook.

In a modification of the present invention, a single winch having two rope drums is employed and is coupled in such a way that, for raising and lowering the load, only the drum of the hoisting rope is actuated, while during the transfer of the load both drums are connected to the winch drive. In each embodiment of the invention, the winch motors can be so designed and connected that, during the transfer of the load, the ropes travel at the same, or approximately the same, speed, one of the ropes being unwound, while the other rope is being wound. As will be explained more fully hereinafter, there is usually a substantial difference in the output capacity of the two winches, so that, upon reversing the direction of the load transfer, the power units must be interchanged.

It is therefore an object of the present invention to provide a cargo handling apparatus of the type above described which is of simple construction and easy to operate.

It is another object of the invention to provide a cargo handling apparatus that can operate with a smaller power output, and which consumes less energy.

Another object of the present invention is to provide a cargo handling apparatus which enables a quicker and more efficient cargo handling operation.

It is a further object of this invention to provide such apparatus as will eliminate delays in the transfer of cargo.

Other objects and advantages will be apparent from the following description when read in connection with the accompanying drawings in which:

FIGURE 4 shows a cross-section of the hull of a ship with the apparatus of the present invention installed thereon.

FIGURE 5 shows the speed diagram of a loading operation effected with the apparatus of FIGURE 4.

FIGURE 6 shows the path of the point of intersection of the rope and the load during the transfer of the load from right to left, as shown in the drawing.

FIGURE 7 shows a modification of the basic embodiment illustrated in FIGURE 4.

Referring now particularly to FIGURE 4 of the drawing, it can be seen that cargo load **3** is suspended from the hoisting rope **4** which travels over a loose block **5** secured to guide rope **6**. Hoisting rope **4** leads over a sheave **7** fixed to the loading boom **8** to a hoisting winch **9**, and guide rope **6** leads over sheave **10** fixed to loading boom **11** and onto a guide winch **12**. As it is well known that the hoisting rope **4** is subjected at all points to the same load corresponding to the weight of the cargo load, the direction of the guide rope **6** is automatically shifted during the transfer of the cargo load always in the sense that a projected extension of this direction beyond loose block **5** would cut the angle which the hoisting rope **4** forms at the loose block **5** exactly in half.

The cargo handling operation is illustrated in FIGURES 5 and 6, and can be further explained as follows: In FIGURE 5, the diagram of hoisting winch **9** is shown in solid lines, while the diagram of guide winch **12** is shown in dotted lines. In these two figures, the points *a*, *b*, *g* and *h* are identical to the corresponding points of FIGURES 2 and 3, which, as before stated, are representative of the teachings of the prior art.

Referring still to FIGURE 5, at the start of the cargo handling operation, the hoisting winch **9** lifts the cargo **3** toward point *b*, while guide winch **12** remains idle. From point *b*, both winches rotate in opposite directions at the same speed until the cargo load has reached point *g*. During this travel, the loose block **5** moves along line

c; and cargo load 3 moves along a line which is horizontal for all practical purposes. At point *g*, the guide winch **12** is cut out, while hoisting winch **9** continues to travel at the same speed and deposits the cargo load at *h*. While returning the empty hook, the winches operate in the reverse sequence.

The drum of guide winch **12** is suitably driven by a winch motor **13** which is preferably connected to a conventional self-braking worm-gear drive, or equivalent mechanism which, as such, forms no part of the present invention and, accordingly, is neither shown in the drawings nor further described hereinafter. In view of the fact that, during the load transfer operation, motor **13** drives the worm-gear only in the load lowering direction and is subjected to only a small load when the empty hook is returned, the output capacity of this motor can be held to a low value. Therefore, only the hoisting winch **9** must be adapted to supply the much greater power requirements necessary for raising and lowering the cargo load.

The speed diagram of FIGURE 5 shows that the two winches **9**, **12** do not work in the same direction at any point of the cargo handling path. Therefore, the maximum capacity of the hoisting winch need not be any greater than that required to raise the cargo load vertically.

During the transfer of the cargo load, the motor **13** of the hoisting winch **12** takes supply current from the electric circuit to which it is connected, while the motor **14** of the guide winch **9** (which runs during that period in the direction to lower the cargo load) can be so designed that it feeds back current into the electric circuit. As will be readily understood, the details of electrical circuits or other power means and controls form no part of the present invention. The electric circuits and the motor or power means which drive the winch are controlled in a conventional manner by control devices which enable the operator to suitably effect the cargo handling operation.

It will be understood that the cargo handling operation cannot be reversed without some physical rearrangement of the components. In order to reverse the cargo handling direction, the loading booms could, of course, be interchanged. However, this inconvenience may be obviated by providing the hoisting winch with a second drum on which the guide rope is wound, so that a separate guide winch is no longer required. During the cargo transfer operation, this additional drum is connected over a worm-gear, or similar mechanism, and a conventional mechanical or electrical coupling with the drive of the hoisting winch in such a manner that it is rotated in the opposite direction to the hoisting drum. Alternately, the drum of the guide rope may be coupled to rotate in the same direction as the drum of the hoisting rope, and, in this latter arrangement, the two ropes would be wound on the respective drums in opposite directions. The diameters of both winch drums are the same in order that the variations in the length of the hoisting and guiding ropes remain commensurate. In this arrangement, the drum of the guide rope may be driven with the full capacity of the hoisting winch. Thus, it becomes possible to have a loading, as well as an unloading, device which does not require the interchange of any cargo handling components.

During the approximately horizontal transfer of the cargo load in each direction, the motor of the hoisting winch need carry only the load of the frictional forces that are produced and, of course, the practically negligible forces for overcoming the small differences in height, as illustrated in FIGURE 6 of the drawing. In this arrangement, the cargo handling operation may be controlled by means of a single lever which is adapted to regulate in one control plane the raising and lowering

of the load and in another control plane the transfer of the cargo load.

An improved horizontal guiding of the loose block **5** may be obtained with the modified arrangement represented schematically in FIGURE 7 of the drawing. According to this embodiment, an auxiliary rope **21** is connected between the two loading booms **8** and **11** and is attached directly to one boom while it is secured to the other boom over a spring device **22**. Loose block **5**, in addition to being connected to guide rope **6**, is connected in this arrangement also to a loose block **23** through which auxiliary rope **21** is led. Loose block **23** is adapted to ride on auxiliary rope **21** which extends approximately in the same vertical plane as the two ropes **4** and **6**. The length of this auxiliary rope is suitably so proportioned that the path of block **23** approaches approximately that of line C in FIGURE 6 of the drawing, without causing an undesirably high stress of the auxiliary rope **21**.

In the arrangements disclosed, the loading booms are suitably of the same length. However, if there is a difference in the length of the loading booms in an arrangement where two winches are employed, the hoisting rope should be affixed to the longer of the two loading booms.

I claim:

1. Apparatus for loading and unloading cargo on ships comprising first and second loading booms, first and second sheaves connected to said first and second loading booms respectively, a guide rope leading over the first sheave to a first loose block, a load rope leading over said second sheave and over said first loose block to a load hook for lifting and lowering cargo, an auxiliary cable connected between said first and second loading booms, means for resiliently connecting said auxiliary cable to at least one of said loading booms, a second loose block connected to said first loose block, and adapted to travel on said auxiliary cable wherein the altitude of said first and second loose blocks is limited by said resilient connection and said auxiliary cable.

2. The apparatus of claim 1 wherein said resilient connecting means is a spring device connected to said second loading boom and wherein said auxiliary cable is directly connected to said first loading boom.

3. Apparatus for loading and unloading cargo comprising first and second loading booms, first and second sheaves connected to said first and second loading booms respectively, an auxiliary cable connected to each of said first and second booms, resilient means for connecting the auxiliary cable to at least one of said booms, winch means having a load drum and a guide drum, a guide rope leading from said guide drum over said first sheave to a first loose block, a load rope leading from said load drum over said second sheave and over said first loose block to a loading hook, a second loose block connected to said first loose block at a substantially constant distance therefrom and adapted to travel on said auxiliary cable, said load drum and guide drum being operable to pull said load rope and said guide rope simultaneously over said first and second sheaves so that said cargo is transported between said first and second booms at a substantially constant altitude.

4. The apparatus of claim 3, wherein said load drum pulls said load rope to lift and lower said cargo and wherein said load drum and said guide drum each pull said load rope and guide rope to transport said cargo at a substantially constant altitude when said drums pull said load rope and said guide rope at substantially the same rate of speed.

5. The apparatus of claim 3 wherein said resilient connecting means is a spring device.

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