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(54) IMPROVEMENTS IN OR RELATING TO THE TRANSSHIPMENT OF LOADS AT SEA

(71) We, COMPAGNIE FRANCAISE DES PETROLES, a French Corporate Body, of 5 rue Michel-Ange 75781 Paris Cedex 16 France, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention concerns the transshipment of loads at sea, and in particular the transshipment of a load between a vessel and a landing stage, using a conventional form of lifting apparatus, such as a crane, winch or overhead gantry, for example, the lifting apparatus being mounted on the landing stage which is at a fixed level, or at a level which varies only within very narrow limits.

Lifting of loads from a vessel does not pose any problems if movement of the vessel relative to the landing stage is slight, or if the loads are lifted from the deck with the aid of an anti-pounding system which is accurately set up for the particular vessel and landing stage.

It is often impossible to install such devices, however, either because of lack of room, or because vessels are subject to excessive variations of level, especially in seas where the difference in height of the wave crests and troughs can be as much as twenty metres. Even when such extreme variations are not encountered, experience shows that there is a danger of loads being struck or tipped during raising when the waves succeed one another at a relatively high rate. Even if lifting of the load is begun on one wave crest, there are occasions on which heavy loads, say of one tonne and upwards, cannot be raised high enough quickly enough before the next wave crest lifts the vessel, with the consequent risk of the load suspended from the lifting cable striking the deck or some other part of the vessel or its rigging. It might be thought that this could be avoided by the use of more powerful motors in the lifting apparatus, but such measures would result in unacceptable increases in size and cost.

According to the invention there is provided a method of transferring a load at sea to reduce the risk of collision between a vessel and the load after the load had been lifted from the vessel by a lifting device external to the vessel and while the load is suspended from the lifting device in the event that the vessel rises above that level at which the weight of the load was taken by the lifting device, the method comprising rapidly increasing the height of the load from its supporting means on the vessel by lowering the supporting means which have been raised relative to the vessel prior to the weight of the load being taken by the lifting device.

In a preferred embodiment, without abandoning the conventional methods of taking a load from the deck of a vessel and placing it on a landing stage, the lifting apparatus being located on the landing stage and the lifting mechanism being operated after attachment to the load to take the weight as soon as the vessel is lifted by a wave crest to its highest point, the load is first placed on the supporting means which is in a raised position relative to a base on which it is supported, the load supporting means being lowered as soon as the weight is taken by the lifting device to begin lifting the load, lowering of the load supporting means being triggered manually or automatically in response to the weight of the load being taken by the lifting device.

This method forms a gap of a predetermined size between the load and the level of the wave crest by which the boat was lifted at the moment lifting of the load was started. Thus even if the succeeding crest is higher by as much as the distance through which the support is lowered, the load is inevitably raised above the highest position

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of the lowered supporting means at the time of the second crest, so avoiding the risk of the load colliding with the vessel.

Another advantage of this method is that it avoids the need to operate the lifting motor at maximum power, because of the additional gap between the sea and the load provided by the difference between the raised and lowered levels of the load supporting means. This additional gap also means that greater loads can be lifted at lower speeds.

The risk of collisions can be eliminated or at least considerably reduced by the use of this method without it being necessary to time the beginning of the lifting operation to coincide with the vessel being lifted to the highest point by a wave.

Assume for the moment that this method is not used. The normal lifting speed of a crane is about 1.2m/sec, so, to avoid the risk of the raised load striking any point of the vessel as the latter is lifted by the next wave, the ratio of the height of the waves to their half-period must be less than 1.2m/sec. Statistical studies show that there is a high risk of collision occurring, because for wave heights of 3 to 6 metres the period of the swell must be higher than a value of between $2 \times 6/1.2 = 10$ sec and $2 \times 3/1.2 = 5$ sec. This condition applies to 15 to 80% of wave conditions. If the above described method is used, however, and the load supporting means is mounted on a lifting mechanism that can lower it from any level at a speed v, it can be seen that the ratio is diminished, giving minimum swell periods of 4 to 7 seconds, which applies to 50 to 90% of wave conditions. Thus the above described method can provide a gap betwen the load and the supporting means sufficiently quickly for the waves to be ignored thereby eliminating the risk of the load striking the vessel.

The supporting means may comprise a lower platform supporting a bladder-bellows or jack forming the lifting and lowering means, the lower platform being coupled to a load support platform by an articulated system, whereby the two platforms protect the lifting and lowering means in both the raised and the lowered position of the load support platform.

This form of device may be used in association with similar or identical devices making up an assembly able to support a wide variety of shapes and weights, two, three o rmore units being used, for example, to support very wide loads. The device is compact, and devices can easily be stacked upon one another. Each device may be fitted with accessories, for example pressure gauges, adjustable valves for rapid evacuation of the inflating fluid, locking devices, and the like, in fact with all forms of auxiliary equipment useful for carrying out the above described method.

The invention will be more fully understood from the following description of an embodiment thereof, given by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of a landing stage showing the raising of a load from a vessel without use of the invention;

Figure 2 shows the variation with time of the relative positions of a vessel and of a load being lifted from the vessel;

Figure 3 shows the relative positions of a load and a vessel before and after lifting of the load in accordance with an embodiment of the invention; and

Figure 4 is a schematic side view of an embodiment of apparatus in accordance with the invention.

The landing stage 1 shown in Figure 1 includes a lifting device shown schematically as comprising a control cabin 2 from which a boom 3 extends and a pulley 4 at the end of the boom and over which a lifting cable 5 runs, the cable being attached by means of a hook 6 to a load 7 on the deck 8 of a vessel 9. In the position shown in this Figure, the slack in the cable 5 has just been taken up prior to raising the load onto the landing stage 1.

If the level of the sea 10 corresponds to the crest of a wave, the situation is most favourable for raising the load 7 sufficiently high above the deck 8 before the arrival of the next wave crest. Even so there is still some risk that the load 7 will strike the deck or part of the rigging of the vessel if the second wave crest is higher than the first and the load has not been raised far enough in the relatively short space of time between successive wave crests.

The risk of such a collision is more clearly apparent from Figure 2, where it has been supposed that the slack in the cable 5 has been taken up at the moment when the level of the sea 10 corresponds to a trough, or is still falling to the lower level 12. If the difference in level between the trough 12 and the following crest is 6 metres, it is clear that impact will occur at time T2 or earlier, if for example the load 7 is raised at the normal rate of 1.2m/sec and the half-period of the swell is less than 4 seconds. In 4 seconds the load 7 will be raised by 4.8 metres and it is assumed that the bottom 13 of the load is 1.2 metres above the deck 8 at time T1. Thus the possibility of impact exists, as the half-period of the swell may be as little as 3 seconds, as shown in Figure 2.

This risk is increased if the plane of the deck 8 does not correspond with the horizontal plane 14 at the moment the wave crest passes, because of rolling or pitching

of the vessel. This can cause the load 7 to strike e.g. the rigging or the bulwarks 33, even if the half-period of the swell is greater than 4 seconds and the difference in levels is less than 6 metres.

To eliminate or at least reduce this risk, in accordance with the invention, and as shown in Figure 3, the load 7 is initially raised on a lifting device 16 which is capable of dropping quickly enough to avoid subsequently striking the load itself. The lifting device 16 may have the form shown in Figure 4.

The device 16, shown schematically in Figure 4, comprises one or more of a bladder 25 or a bellows 26, and a jack 27, which operates an articulated system of arms 19, 20 supporting a load support platform 17 on a lower platform 18. To simplify the Figure, it has been supposed that the jack 27 has raised the platform 17 by pulling on the arm 19, which is pivoted on the lower platform 18 by its lower end, until a pin 24 at the upper end of the arm 19 reaches the end of a slot 22 in the load support platform 17. The upper end of the arm 20 is pivoted to the platform 17 and has at its lower end a pin 23 sliding in a slot 21 in the lower platform 18. It will be evident that the articulated system is designed so that when the jack 27 ceases to pull on the arm 19, or when its action is reversed so as to push on the arm 19, the pins 23 and 24 slide the other way, to the opposite ends of the slots 21 and 22. The slots are in practice rather longer than as shown in the Figure, with the result that the load support platform 17 can drop down onto the upper surfaces 30 of side members 29 of the lower platform 18, which surfaces 30 form stops for limiting downward movement of platform 17. The system for controlling the raising of the platform 17 is shown schematically at 28. When actuated, manually or automatically, this brings about the inflation or deflation of the bladder 25 or the bellows 26, or the pull or push action of the jack 27, as the case may be. In each case, all that is required is to apply pressure to a circuit or to release the pressure in a circuit, the fluid inlet and outlet conduits of the circuit being shown schematically at 31 and 32. The control system 28 and associated devices may be designed simply to raise the platform 17 in the absence of a load and to keep it in the raised position when loaded. With the bladder 25 or bellows 26 the fluid may be air.

The platform 18 may be fixed to the deck 8, and the platform 17 provided with a pallet 15 for facilitating positioning of the load on it. The pallet 15 may be connected to the control system 28, as shown schematically by connection 34, to trigger the descent of the platform 17 automatically as soon as the load 7 is raised from the pallet 15 Alternatively, this may be done by remote control from the control cabin 2 on the landing stage.

Refering back to Figure 2, it will be seen that if the load had been lifted at the same moment in time, but had been placed beforehand on a device 16, as shown in Figure 3, so that the load was e.g. 1.2 metres above the deck, then the load would start at a higher position than that shown in Figure 2, so that the risk of collision would be reduced, the load 7 only needing to be raised through 3.6 metres instead of through 4.8 metres as in the example given.

It is evident that there would be no risk of collision if the lifting of the load had begun at the moment the first wave crest passed, with the deck 8 of the vessel at the level 14, and if the following crest had been on the same amplitude as the first But supposing that a mistake had been made, resulting in the situation shown in Figure 3, with the load 7 resting on the device 16. All that would be required in order to avoid all risk of collison would be to wait for the next wave crest at time T2 and simultaneously commence lifting the load, by applying tension to the cable 5, and lower the support platform 17 of the device 16, lowering of the platform being triggered manually or otherwise. This situation, not shown, would result in the load being the same distance from the deck 8 at time T2 as is shown at time T1, at which the device 16 has not been lowered.

It should be noted that even in the worst possible case, when the passage of the wave crest is misjudged because the amplitude of the crest is greater than that of the preceding one, the sudden lowering of the platform 17 would at least compensate for the increased wave amplitude, and would avoid an impact at time T2.

Thus, ignoring cases in which there is no risk of collison due to coincidence of the lifting of the load with the passage of a wave crest, the use of the above described method and device enables the risk of collision to be avoided or at least substantially reduced, provided that the distance through which the platform 17 drops is sufficient. Even in the worst possible case, when this distance is small in comparison with the variation in the height of the wave crests, the use of the method and device reduces the incidence of such collisions.

While the invention has been described in connection with unloading, it is also applicable to the loading of a ship, and especially to the loading of a ship at the quayside, loads being slid onto the raised platform on the crest of a wave and the platform then being lowered to drop the load to deck

level for stowage.

Any kind of lifting apparatus may be used in place of the device 16 for transshipment at sea, the apparatus being lowered at a speed of at least 0.5m/sec for waves in excess of 3 metres, to produce the interval required for elimination of collisions. The interval could be further increased by using a lifting apparatus and a device as described above one on top of the other, the increase in the gap and in the speed with which the gap is generated increasing the tolerance in respect of the determination of the instant at which to begin lifting the load.

WHAT WE CLAIM IS:—

1. A method of transferring a load at sea to reduce the risk of collison between a vessel and the load after the load has been lifted from the vessel by a lifting device external to the vessel and while the load is suspended from the lifting device in the event that the vessel rises above that level at which the weight of the load was taken by the lifting device, the method comprising rapidly increasing the height of the load from its supporting means on the vessel by lowering the supporting means which have been raised relative to the vessel prior to the weight of the load being taken by the lifting device.

2. The method according to claim 1 in which the supporting means are lowered simultaneously with the weight being taken by the lifting device.

3. The method according to claim 1 or claim 2 in which the lowering of the supporting means and the taking of the weight by the lifting device are coincident with the passage of a wave crest beneath the load.

4. The method according to any of the preceding claims in which the increase in height is at least equal to the probable difference in height between two successive wave crests.

5. The method according to any of the preceding claims in which lowering of the supporting means is subordinated to the lifting device taking the weight.

6. The method of transferring a load at sea substantially as herein described.

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