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(54) VESSEL HANDLING EQUIPMENT

(71) We, TAYLOR WOODROW INTERNATIONAL LIMITED, a British company, of Western House, Western Avenue, London W5 1EU 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:—

This invention relates to vessel handling equipment, and is particularly concerned with equipment for manoeuvring vessels through a restricted channel and positioning the vessels in that channel, for example hauling a VLCC into a dry dock and positioning the vessel therein prior to dewatering of the dock, maintaining the vessel in position during the dewatering of the dock, and effecting the subsequent outward journey of the vessel.

According to the present invention there is provided vessel handling equipment for manoeuvring a vessel with respect to a restricted channel, the equipment comprising a rail along each side of the restricted channel, a trolley mounted on each rail, winch mechanism associated with each rail and from which a rope or cable can be passed over guide means on each trolley to a vessel to be manoeuvred, rope or cable brake means on each trolley for locking the trolley fast with the rope or cable passed over the guide means of this trolley, and rail brake means for locking each trolley fast with the rail on which it runs; whereby with the ropes or cables passed over the guide means and attached to a vessel, in a first operating condition in which the rope or cable brake means are released and the rail brake means are engaged to lock the trolleys fast with the rails the ropes or cables can be individually winched to position a vessel with respect to the restricted channel; whereas in a second operating condition in which the rope or cable brake means are engaged to lock the trolleys fast with the ropes or cables and the rail brake means are released the ropes or cables can be individually winched to haul the trolleys along the rails and hence man-

oeuvre the vessel with respect to the channel.

A further feature of the invention is that each rail can be formed of cast concrete providing a pair of load bearing surfaces disposed to prevent derailment brought about by rotation of the trolley about the rail, the trolley having load bearing wheels that run on each of these load bearing surfaces. To locate the trolley with these load bearing wheels running on these load bearing surfaces the trolley can be provided with support wheels moving on further surfaces of the rail. In this arrangement the wheels of the trolley can have resilient tyres.

In a particular embodiment, two further trolleys and associated winch mechanisms are provided each having rope or cable guide means and brake means, and rail brake means, so that ropes or cables passed from the winch mechanisms over these guide means and attached to the vessel give, in connection with the first-mentioned ropes or cables, a four point connection to the vessel.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:—

Figure 1 is a plan view of a trolley and the rail on which it runs of vessel handling equipment,

Figure 2 is a section taken on the line II—II of Figure 1,

Figure 3 is a detail view taken in the direction of arrow III in Figure 1,

Figure 4 is a section taken on the line IV—IV of Figure 1, and

Figures 5A to 5N diagrammatically illustrate operation of the handling equipment.

The vessel handling equipment will be described installed in a dry dock. The equipment includes, along each side of the dock, a rail 1 which is cast in concrete to provide four running surfaces 1A, 1B, 1C and 1D for a trolley 2. Of the rail running surfaces, the surface 1A is vertical and faces outwardly of the dock, the surface 1B is horizontal and faces upwardly, the surface 1C is vertical and faces

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inwardly of the dock, and the surface 1D is horizontal and faces downwardly.

Four trolleys 2 in all are provided in the equipment, two mounted on one rail and two on the other. Each trolley 2 consists of a framework 3 carrying two rows of resilient-tyred load bearing wheels 4 and 5, each row extending along the whole length of the framework 3, and two sets of pairs of resilient-tyred locating wheels 6 and 7, one pair of each set being at one end of the framework and the other pair of each set being at the other end of the framework. The wheels 4, 5, 6 and 7 run on the rail surfaces 1A, 1D, 1B and 1C respectively, the wheels 4 and 5 rotating about vertical axes and the wheels 6 and 7 rotating about horizontal axes. Thus the surfaces 1A and 1D are load bearing surfaces disposed to resist rotation of the trolley about the rail, whereas the co-operation of the wheels 6 and 7 with the surfaces 1B and 1C serves to locate the trolley with wheels 6 and 7 running on the surfaces 1B and 1C.

The framework 3 of each trolley 2 carries a rope or cable guide in the form of a pulley 8 carried by a bracket 9 that can pivot about a horizontal axis 10 extending longitudinally of the trolley 2, the bracket being supported in bearings 11 and 12. Of these bearings, the bearing 12 is hollow so that, as shown in Figure 1, a rope or cable 13 can be run over the pulley 8, through this hollow bearing 12 and through a rope or cable brake 14 also carried by the framework 3.

The framework 3 additionally carries a rail brake 15, a brake surface 16 (Figure 3) of which is disposed for co-operation with any selected one of steel blocks 17 mounted on the concrete rail 1.

The cable brake 14 provided on each trolley 2 consists, as shown in Figure 4, of a pair of jaws 14A mounting cable grips 14B. One of the jaws 14A is fixed and the other can be pivoted by turning a hand wheel 14C.

The rail brake 15 provided on each trolley 2 consists, as shown in Figure 3, of a pivoted shoe 18 having the brake surface 16. Associated with this shoe 18 are a cocking mechanism 19 and a release mechanism 20. In the block-engaged position illustrated in full lines in Figure 3 the shoe 18 is upright with a nose 18A thereof disposed between pins 21A and 21B carried by an arm 21 that can pivot about the pin 21B. The arm 21 is biased by a spring 22 to its illustrated full line position and the shoe 18 is moved to its upright position by moving the cocking mechanism to its illustrated full line position, an arm 19A thereof acting on the shoe 18. To disengage the shoe 18 from the block 17, the cocking mechanism having been previously returned to a "neutral" position by lowering its lever, the release mechanism is pivoted clockwise to its dotted line position. Dur-

ing this movement of the release mechanism it acts on a pin 21C carried by the arm 21 to pivot the arm 21 anti-clockwise to its dotted line position restrained by the spring 22, and the shoe 18 is thus freed to fall, pivoting clockwise to its dotted line position from which it can be returned to its upright position by pivoting the cocking mechanism 19 clockwise. Blocks 17 for the shoe 18 to engage are provided along each rail 1 at suitable spaced apart locations.

The equipment also includes winch mechanism at each end of each rail 1.

Operation of the equipment will now be described with reference to Figures 5A to 5N.

Figure 5A. The equipment is in readiness to handle a vessel 23 being manoeuvred towards the dock entrance by tugs 24. The two trolleys 2 on each rail 1 are positioned close together at the dock entrance end of the rail 1. Cables 13 run from the trolleys 2 furthest from the dock entrance to winches 25 at the head wall end of the dock.

Figure 5B. Once the vessel has been manoeuvred by the tugs as close as possible to the dock entrance the cables 13 from the winches 25 are attached to the vessel each cable 13 passing through the cable brake 14 of the trolley 2 that is nearest the winch of this cable and over the pulley 8 of this trolley. At this stage the cable brakes 14 are released, but the rail brakes 15 of these two trolleys are applied so that the trolleys are locked against movement along the rails. The tugs 24 are deployed to urge the vessel 23 into line with the dock, counteracting any wind or water action as represented by the arrow 26, and the winches are operated to assist in the alignment operation, and to haul the vessel towards the dock entrance.

Figure 5C. When the runs of the cables 13 between the vessel 23 and the pulleys 8 reach a desired angle, the winches are momentarily halted, the cable brakes 14 are applied and the rail brakes 15 are released.

Figure 5D. The winches 25 are started up again to haul along their rails 1 the two trolleys 2 with which the cables 13 are locked fast by the brakes 14, and hence the vessel 23 is hauled into the dock guided by the trolleys 2 as they move along the rails 1. The tugs 24 continue to be deployed, to counteract any wind/water action, and to oppose the winch forces, whereby the speed at which the vessel moves into the dock can be determined.

Figure 5E. The vessel 23 is decelerated and brought to a halt before reaching the head wall of the dock, and the two trolleys 2 which have taken part in the hauling-in of the vessel are braked to their rails 1 by applying their rail brakes 15.

Figure 5F. Ropes or cables 13¹ are run

from winches 25¹ at the entrance to the dock over the pulleys 8 and through the rope or cable brakes 14 of the trolleys 2 at this end of each rail 1 (which trolleys have so far not been utilised), and are attached to the vessel 23. There is now a four point cable attachment arrangement between the vessel 23 and the dock based winches 25, 25¹.

Figure 5G. The winches 25, 25¹ are operated as necessary to tension the cables 13 and 13¹, the tugs are released and the dock gate is closed.

Figure 5H. With all four cable brakes 14 released, and all four rail brakes 15 applied, dewatering of the dock is carried out. The winches 25, 25¹ are operated as necessary to maintain the vessel 23 in position to settle onto blocks on the dock floor. The winches 25, 25¹ are similarly operated during subsequent re-floatation to ensure the vessel 23 maintains station in the dock. It will be appreciated that at all times, and particularly during dewatering and subsequent re-floatation, the pulley support brackets 9 pivot to follow the motion of the vessel.

Figures 5I and 5J. When the dock has been re-filled, ropes or cables 27 from the vessel are attached to slip hooks 28 (see also Figures 1 and 2) of each of the trolleys 2 that are at the head wall end of the dock, and the cables 13 from the associated winches 25 to these trolleys 2 are released from the vessel and attached to shackles 26 (Figure 1) as shown in chain dot lines 13A in Figure 1. The slip hooks 28 are carried by the pulley support brackets 9 so that they, like the pulleys 8, can follow up and down motion of the vessel.

Figure 5K. The dock gates are opened and tugs 24 are attached to the vessel 23.

Figure 5L. The cables 13¹ from the trolleys 2 at the entrance to the dock are released from the vessel 23 and shackled (for convenience) to these trolleys 2.

Figure 5M. With the rail brakes 15 of the dock head wall end trolleys 2 released, the tugs 24 are deployed to haul the vessel 23 out of the dock with the winches 25 at the dock head wall end being operated to apply restraining forces via the associated trolleys 2 to which their cables 13 are shackled and the cables 27 from the vessel 23 to the trolley slip hooks 28.

Figure 5N. As the vessel 23 emerges from the dock the trolley slip hooks 28 are released, freeing off the vessel cables 27, and hence releasing the vessel.

It will be noted that only the two trolleys 2 that are to move to the head wall end of the dock and back need to be provided with slip hooks 28, which can be of a conventional design. The blocks 17 for the shoes 18 of the trolley rail brakes are positioned such that the trolleys 2 move to the head wall end of the dock can be braked to the rails

1 at selected positions along the rails, and likewise positions along the rails 1 for the dock entrance end trolleys 2 can be selected. Thus the equipment can be utilised to handle vessels of different lengths in a convenient manner.

It will be appreciated that the equipment can be operated under the control of a shore-based controller in a convenient manner.

It will also be appreciated that the equipment described could be utilised in conjunction with restricted channels other than dry-docks, for example locks in canals.

WHAT WE CLAIM IS:—

1. Vessel handling equipment for manoeuvring a vessel with respect to a restricted channel, the equipment comprising a rail along each side of the restricted channel, a trolley mounted on each rail, winch mechanism associated with each rail and from which a rope or cable can be passed over guide means on each trolley to a vessel to be manoeuvred, rope or cable brake means on each trolley for locking the trolley fast with the rope or cable passed over the guide means of this trolley, and rail brake means for locking each trolley fast with the rail on which it runs; whereby with the ropes or cables passed over the guide means and attached to a vessel, in a first operating condition in which the rope or cable brake means are released and the rail brake means are engaged to lock the trolleys fast with the rails the ropes or cables can be individually winched to position a vessel with respect to the restricted channel; whereas in a second operating condition in which the rope or cable brake means are engaged to lock the trolleys fast with the ropes or cables and the rail brake means are released the ropes or cables can be individually winched to haul the trolleys along the rails and hence manoeuvre the vessel with respect to the channel.

2. Vessel handling equipment as claimed in claim 1, wherein each rail is formed of cast concrete.

3. Vessel handling equipment as claimed in claim 1 or 2, wherein each rail includes a pair of load bearing surfaces disposed to prevent derailment of the trolley mounted thereon brought about by rotation of the trolley about the rail, the trolley having load bearing wheels for running on each of these load bearing surfaces.

4. Vessel handling equipment as claimed in claim 3, wherein each trolley is provided with further wheels that run on further surfaces of the associated rail to locate the trolley with respect to the rail such that said load bearing wheels run on said load bearing surfaces.

5. Vessel handling equipment as claimed in claim 4, wherein, with respect to the restricted channel, one of said load bearing surfaces is vertical and faces outwardly and



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It will also be appreciated that the equipment described could be utilised in conjunction with restricted channels other than dry-docks, for example locks in canals.

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2. Vessel handling equipment as claimed in claim 1, wherein each rail is formed of cast concrete.

3. Vessel handling equipment as claimed in claim 1 or 2, wherein each rail includes a pair of load bearing surfaces disposed to prevent derailment of the trolley mounted thereon brought about by rotation of the trolley about the rail, the trolley having load bearing wheels for running on each of these load bearing surfaces.

4. Vessel handling equipment as claimed in claim 3, wherein each trolley is provided with further wheels that run on further surfaces of the associated rail to locate the trolley with respect to the rail such that said load bearing wheels run on said load bearing surfaces.

5. Vessel handling equipment as claimed in claim 4, wherein, with respect to the restricted channel, one of said load bearing surfaces is vertical and faces outwardly and





- the other is horizontal and faces downwardly, and one of said further surfaces is horizontal and faces upwardly and the other is vertical and faces inwardly; the wheels that run on the vertical surfaces rotating about vertical axes and the wheels that run on the horizontal surfaces rotating about horizontal axes.
6. Vessel handling equipment as claimed in any one of claims 3 to 5 wherein the wheels of each trolley have resilient tyres.
7. Vessel handling equipment as claimed in any one of the preceding claims, wherein the rail brake means comprise a brake surface carried by each trolley for selective co-operation with any one of a plurality of blocks fast with the associated rail.
8. Vessel handling equipment as claimed in claim 7, wherein the brake surface of the rail brake means of each trolley is on a shoe pivotably mounted on the trolley and having cocking and release means associated with it.
9. Vessel handling equipment as claimed in claim 8, wherein said cocking means comprises a pivotable arm that can be moved to act on the shoe to move it to an upright block-engaging position; and wherein said release means comprises a further pivotable arm that can engage the shoe to retain it in said upright position, and that can be pivoted to release the shoe to permit the shoe to move from said upright position.

10. Vessel handling equipment as claimed in any one of the preceding claims, wherein said guide means on each trolley includes a pulley that can pivot about a horizontal axis extending in the direction along the rail on which the trolley is mounted.

11. Vessel handling equipment as claimed in any one of the preceding claims and comprising two further trolleys and associated winch mechanisms, each such further trolley having rope or cable guide means and brake means, and rail brake means, so that ropes or cables passed from the winch mechanisms over these guide means and attached to the vessel give, in connection with the first-mentioned ropes or cables, a four point connection to the vessel.

12. Vessel handling equipment, substantially as hereinbefore described with reference to the accompanying drawings.

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