Dec. 8, 1959 W. A. HUNSUCKER 2,916,002

MARINE HOISTING APPARATUS

Filed April 26, 1957 2 Sheets-Sheet 1

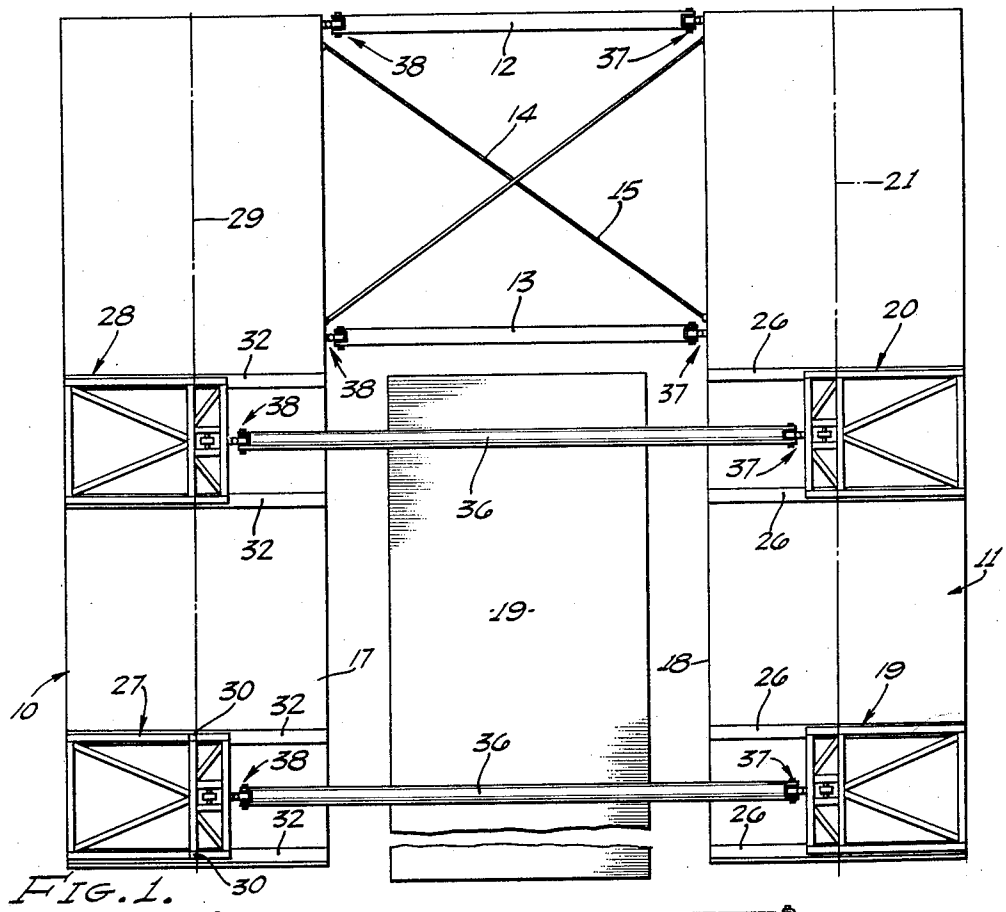


FIG. 1.

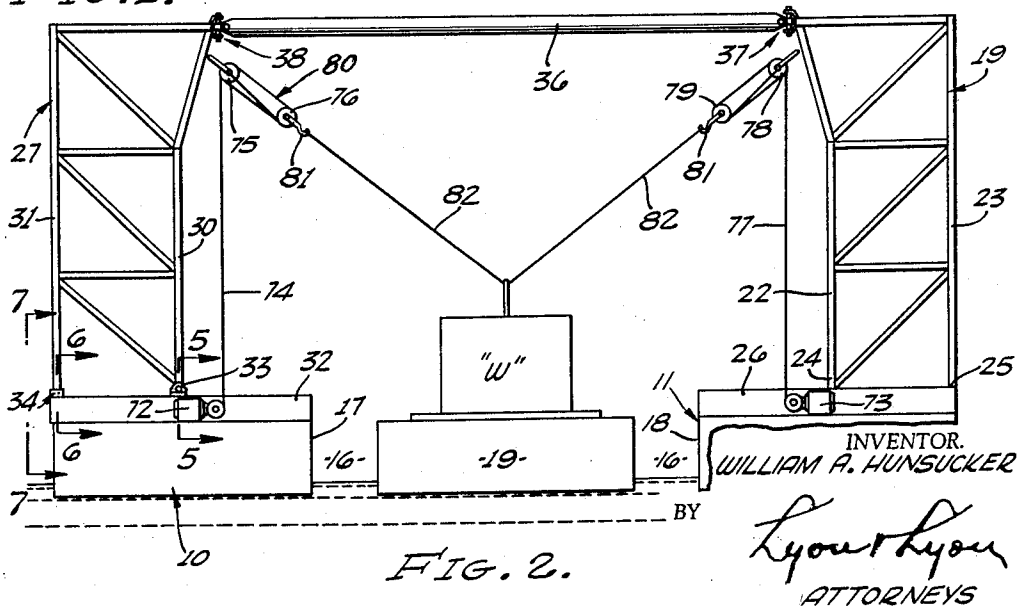


FIG. 2.

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MARINE HOISTING APPARATUS

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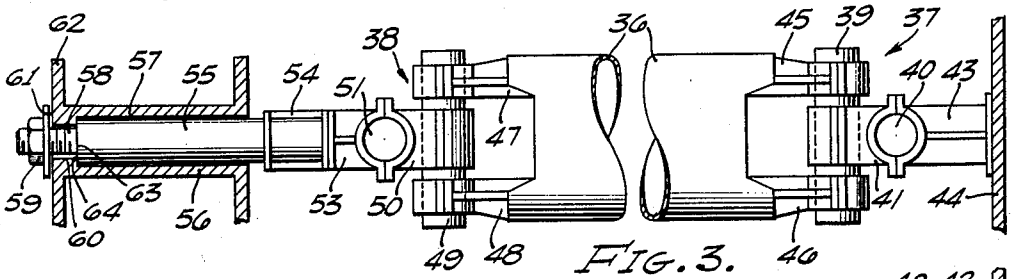


FIG. 3.

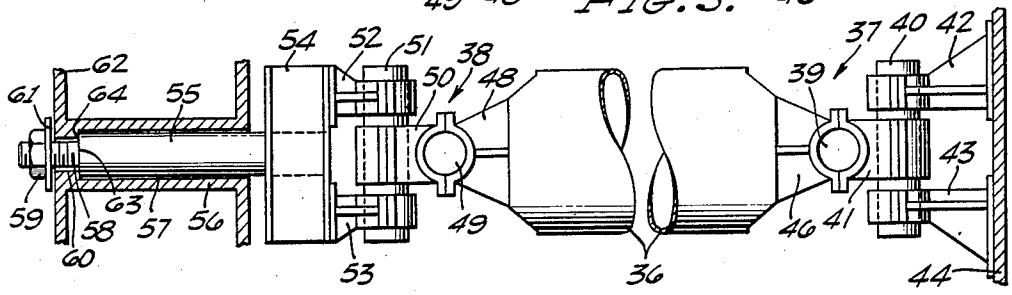


FIG. 4.

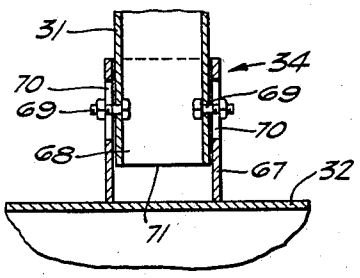


FIG. 6.

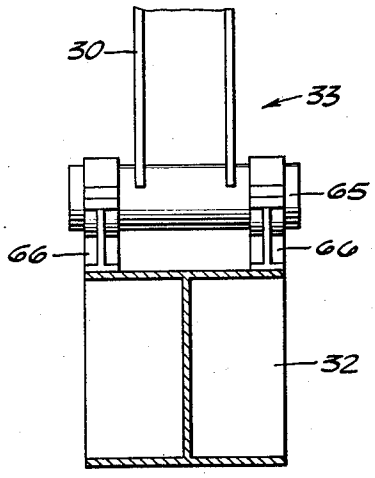


FIG. 5.

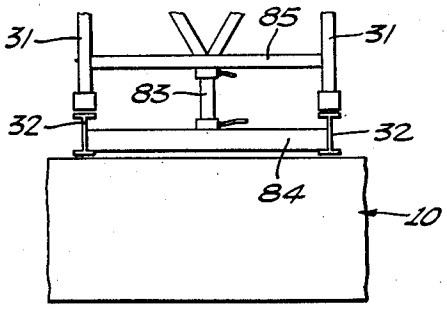


FIG. 7.

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MARINE HOISTING APPARATUS

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Application April 26, 1957, Serial No. 655,351

15 Claims. (Cl. 114—.5)

This invention relates to marine hoisting equipment of the type employed in marine construction operations wherein heavy machinery, structural members, or other objects must be lifted or supported in or over a body of water. This invention relates to improvements over the device shown in my copending application for Portable Marine Structure and Method of Installation filed October 25, 1954, Serial No. 464,255.

This invention has particular usefulness when employed to lift very heavy loads such as are encountered in marine salvage operations, construction of offshore well drilling platforms and the like. Present day marine hoisting devices have a maximum lifting capacity of approximately eight hundred tons under ideal conditions, whereas apparatus embodying the present invention can readily be employed for lifting larger loads. Furthermore, such present day hoisting devices are extremely expensive to construct and operate, whereas apparatus employing the present invention is relatively inexpensive to construct and can readily be supported on conventional steel cargo barges.

Conventional marine hoisting devices commonly employ a single floating barge which tends to cant or tilt under the weight of the object being lifted, whereas in the apparatus embodying the present invention, two floating barges are employed with the result that the tendency to tilt the barges when lifting a load is substantially eliminated, and this is accomplished while permitting each barge to respond freely and independently to wind and wave action.

Accordingly, it is an important object of this invention to provide apparatus for lifting heavy loads over or in a body of water by means of two spaced floating barges or other buoyant members, in such a manner that each floating member may pitch and roll independently of the other.

Another object is to provide marine hoisting apparatus comprising two interconnected floating barges spaced by struts that permit the barges to respond freely and independently to wind or wave action without inducing undue stresses in the barges or the struts.

Another object is to provide marine hoisting apparatus for lifting and supporting loads over or in a body of water by means of two floating barges or buoyant members spaced apart by means of struts, each barge having a tower mounted thereon and a strut extending between the towers at an elevated position in such manner that turning movement is permitted at each end of the strut and between one of the towers thereby permitting the barges to pitch and roll independently.

Another object is to provide means in marine operations whereby very heavy objects can be lifted and supported between two buoyant members in such a manner that torsion or rotation on the buoyant members is largely eliminated by means of members interconnecting the buoyant members which cause the forces that normally tend to produce rotation in the case of a hoist mounted on a single buoyant member to mutually cancel each

other. Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

Figure 1 is a top plan view showing a preferred embodiment of my invention.

Figure 2 is an end elevation thereof.

Figure 3 is a plan view of one of the struts which extends between the towers carried on floating barges, or one of the struts which extend between the barges in order to space them apart.

Figure 4 is a side view of the device shown in Figure 3.

Figure 5 is a sectional elevation taken substantially on the lines 5—5 as shown in Figure 2.

Figure 6 is a sectional detail taken substantially on the lines 6—6 as shown in Figure 2.

Figure 7 is a fragmentary side elevation taken in the direction of lines 7—7 as shown in Figure 2.

Referring to the drawings, a pair of floating barges or other buoyant members **10** and **11** are held in spaced position by means of struts **12** and **13** and by means of angularly positioned tension elements **14** and **15**. Thus the system of tension members **14** and **15**, in combination with the struts **12** and **13**, prevent relative longitudinal movement of the barges. A space **16** is thus defined between the sides **17** and **18** of the barges **10** and **11** respectively. A work carrying barge **19** is adapted to be received within this space **16**.

The work generally designated W is shown diagrammatically in Figure 2. The barge **11** is provided with towers **19** and **20**. The towers are substantially duplicates and each includes a plurality of structural columns **22** and **23** fixed at their lower ends **24** and **25** to the transverse girders **26**. The girders **26** are fixed to the barge **11**.

The barge **10** is provided with towers **27** and **28**. The towers are substantially duplicates and each includes a plurality of structural columns **30** and **31**. The inner columns **30** are pivotally connected to the girders **32** by means of a pivot assembly generally designated **33**. The axes of these pivot assemblies **33** are coincident. The outer columns **31** are connected to the girders **32** by means of a lost motion connection assembly generally designated **34**. This assembly permits limited rocking or turning movement of the towers **27** and **28** with respect to the barge **10**. The girders **32** are each fixed to the barge **10**.

Struts **36** extend between the towers **27** and **19** and between the towers **28** and **20**. These struts extend at an elevated position. One end of each strut **36** is connected to a tower by means of a self-aligning connection **37** and the other end by means of a self-aligning and rotating connection **38**.

As best shown in Figures 3 and 4, the self-aligning connection generally designated **37** includes a pair of pivot pins **39** and **40** mounted substantially at right angles and connected by bracket **41**. Yoke parts **42** and **43** connect the pin to the plate **44** carried on one of the towers. Similarly, yoke parts **45** and **46** connect the pin **39** to one end of the strut **36**. From this description it will be understood that a gimbal joint connection permitting universal turning movement is provided by means of the pins **39** and **40** and associated parts.

The other end of each of the struts **36** is connected to one of the towers by means of a self-aligning and rotary connection generally designated **38**. Yoke arms **47** and **48** fixed to the strut **36** support pivot pin **49**. A bracket **50** holds the pivot pin **51** in substantially right angle position with respect to the pin **49**. Yoke arms **52** and **53** support the pin **51** on the cross head **54**. The cross head is provided with a shank **55** which projects into a spool member **56** fixed on one of the towers. The shank **55** is free to turn within the bore **57** of the spool **56**. The projecting end **58** of the shank **55** is reduced in

size and threaded to receive the nut 59. This end 58 of the shank projects through a smaller opening 60 in the spool 56 so that endwise movement of the shank 55 and cross head 54 are limited by engagement of the washer 61 with the spool end surface 62 and by engagement of the shank shoulder 63 with the internal abutment 64 on the spool 56. From this description it will be understood that the self-aligning and rotary connection 38 at the end of the strut 36 permits universal turning movement to the strut 36 with respect to the cross head 54 and also permits turning movement of the strut about its longitudinal axis with respect to the spool 56.

Although the connections 38 have been shown between the struts 36 and the towers 27 and 28, it will be understood that the connections 38 may be placed at either end of the strut 36 as desired. Similarly, self-aligning connections 37 may be placed at one end of the struts 12 and 13 and self-aligning and rotary connections 38 may be placed at the other end thereof. The barges 10 and 11 are therefore permitted to roll independently about their longitudinal center lines 29 and 21, respectively, and to pitch independently in a longitudinal direction while at the same time remaining spaced apart in predetermined relationship. The struts 36 which connect the upper ends of the towers have self-aligning movement with each of the towers and the connections 38 allow for relative rotary movement between the struts and the towers 27 and 28.

As shown in Figure 5, each of the pivotal connections 33 includes a pivot pin 65 and serves to join the inner columns 30 to the girders 32. Pivot pin 65 is received within bearing support 66 fixed on the girder 32. The towers 27 and 28 are thus mounted for pivotal movement or rocking motion. There are two locations for the pivotal connections 33 for each tower 27 and 28 which thus limits the rotation of each of these towers to one plane.

As shown in Figure 6, the lost motion connection generally designated 34 includes an upright guide box 67 fixed to the girder 32 and slidably receiving the lower end 68 of the outer column 31. Bolts 69 mounted on the column 31 extend through vertical slots 70 provided on the fixed box 67 to permit limited vertical movement of the columns 31 with respect to the girders 32. Downward movement of the columns 31 is arrested by engagement of the lower end 71 of the column 31 with the upper surfaces of the girders 32, and upward movement is limited by engagement of the bolt 69 with the upper ends of the slots 70. During normal roll of the barges 10 and 11 about their longitudinal axes 29 and 21 respectively, the columns 31 of the tower 27 and 28 move freely between these limits of motion.

Hoisting apparatus is mounted on the barges and towers and as shown in the drawings, this apparatus may comprise power operated winches 72 and 73 mounted on barges 10 and 11 respectively. Cables 74 extend from the winches 72 and pass around tackle blocks 75 and 76. Similarly, cables 77 extending from winches 73 pass around tackle blocks 78 and 79. Each tower may support one of the tackle block assemblies 80 and a winch may be used with each tower. (The winches are omitted in Figure 1 for clarity of illustration.) A hook or other load supporting device 81 is carried by each of the tackle blocks 76 and 79 and conventional lifting slings 82 extend from the hook 81 to the work W. Operation of the winches 72 and 73 serves to raise or lower the work W. During the hoisting operations the barges 10 and 11 are free to pitch and roll independently by reason of the connections 37 and 38 and the pivotal joints 33 at the base of the towers 27 and 28.

In operation the barges 10 and 11 may be towed to the construction site with the struts 12, 13, and 36 disassembled. Upon reaching the construction site, the struts 12 and 13 and the diagonal tension elements 14 and 15 are installed. The struts 36 are then connected at one end to the cross heads 54 which are carried on the upper ends of the towers 27 and 28. This is accomplished by means of auxiliary hoisting equipment (not shown). When the connections 38 have been completely assembled to connect the struts 36 to the towers 27 and 28, a double acting hydraulic jack 83 is placed on the cross member 84 extending between the girders 32 and engaging the structural element 85 which extends between the columns 31 on each of the towers 27 and 28. Actuation of the jack to raise and lower the structural element 85 serves to tilt the tower about its pivotal axis, thereby moving the upper end of the tower back and forth as desired to assist in completing the installation of the self-aligning connection 37. Auxiliary hoisting means (not shown) are provided for raising the ends of the struts 36 so that the connections 37 can be completed. When the assembly of the parts of the self-aligning connection 37 has been completed, the hydraulic jacks 83 have served their purpose and are removed.

While I have shown and described two towers on each of the barges, It will be understood that additional towers may be employed, if desired, or only one tower on each barge may be used.

If desired, the barges 10 and 11 may be moved from one site to another with the struts 12 and 13 and 36 in place. The entire assembly is stable as a unit, and can be transported as a unit, with or without a load being suspended from the hoisting apparatus.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. Marine hoisting equipment of the class described, comprising in combination: a pair of floating barges, strut means spacing the barges so that each may roll and pitch independently of the other, a tower on each barge, means anchoring one of the towers to its barge, means pivotally connecting the other tower to its barge, a strut extending between the towers at an elevated position, means at each end of the strut connecting it for universal tilting movement relative to each of the towers, and means at one end of the strut permitting relative turning movement of the strut about is axis.

2. The combination set forth in claim 1 in which a plurality of towers are mounted upon each barge and wherein a plurality of struts extend between such towers.

3. Marine hoisting equipment of the class described, comprising in combination: a pair of floating barges each having a longitudinal axis, strut means spacing the barges so that each may roll and pitch independently of the other, a tower on each barge, means anchoring one of the towers to its barge, pivot means connecting the other tower to its barge, a strut extending between the towers at an elevated position, means at each end of the strut connecting it for universal tilting movement relative to each of the towers, and means at one end of the strut permitting relative turning movement of the strut about its axis.

4. The combination set forth in claim 3 in which a plurality of towers are mounted upon each barge spaced longitudinally thereof and wherein a plurality of struts extend between such towers.

5. Marine hoisting equipment of the class described, comprising a combination: a pair of floating barges, strut means spacing the barges so that they define a space between them, a tower on each barge, means anchoring one of the towers to its barge, means pivotally connecting the other tower to its barge, a strut extending between the towers at an elevated position, means at each end of the strut connecting it for universal tilting movement relative to each of the towers, means at one end of the strut permitting relative turning movement of the strut about its axis, and hoisting means including elements carried by the towers for lifting a load in the space between the barges.

6. Marine hoisting equipment of the class described, comprising in combination: a pair of floating barges, strut means spacing the barges so that each may roll and pitch independently of the other, a first tower fixed on one barge and movable as a unit therewith, a second tower pivotally mounted upon the other barge for movement about an axis, a strut extending between the towers at an elevated position, gimbal means at one end of the strut connecting it for universal tilting movement relative to one of the towers, an element mounted to turn upon the other of the towers, and gimbal means at the other end of the strut connecting it for universal tilting movement relative to said element.

7. The combination set forth in claim 6 in which a plurality of towers are mounted upon each barge and wherein a plurality of struts extend between such towers.

8. Marine hoisting equipment of the class described, comprising in combination: a pair of floating barges, strut means spacing the barges so that each may roll and pitch independently of the other, a first tower fixed on one barge and movable as a unit therewith, a second tower pivotally mounted upon the other barge for movement about an axis, a strut extending between the towers at an elevated position, gimbal means at one end of the strut connecting it for universal tilting movement relative to one of the towers, an element mounted to turn upon the other of the towers, gimbals means at the other end of the strut connecting it for universal tilting movement relative to said element, and hoisting means including elements carried by the towers for lifting a load from the space between the barges.

9. Marine hoisting equipment of the class described, comprising in combination: a pair of floating barges defining a space between them, a tower on each barge, each tower including load-supporting columns, means anchoring the columns of one of the towers to its barge, means pivotally connecting the inner columns of the other tower to its barge, the other columns of said other tower being movable toward and away from its respective barge, a strut extending between the towers at an elevated position, means at each end of the strut connecting it for universal tilting movement relative to said towers, and means at one end of the strut permitting relative turning movement of the strut about its axis.

10. The combinaion set forth in claim 9 in which a plurality of towers are mounted upon each barge and wherein a plurality of struts extend between such towers.

11. Marine hoisting equipment of the class described, comprising in combination: a pair of floating barges, strut means spacing the barges so that each may roll and pitch independently of the other, means interconnecting the barges acting in cooperation with said strut means to prevent relative longitudinal movement of the barges, an upright member on each barge, means anchoring one of the upright members to its barge, means pivotally connecting the other upright member to its barge, a strut extending between the upright members at an elevated position, means at each end of the strut connecting it for universal tilting movement relative to each of the upright members, and means at one end of the strut permitting turning movement of the strut about its axis relative to one of the connected upright members.

12. Marine hoisting equipment of the class described, comprising in combination: two buoyant members, a pair of struts extending between the two buoyant members, means at each end of each of the struts connecting them to the two buoyant members in such manner as to provide universal tilting movement, means at one end of each of the struts permitting turning movement of the strut about its longitudinal axis relative to one of the connected buoyant members, at least one element extending diagonally between the buoyant members cooperating with said struts to prevent relative longitudinal movement of said buoyant members, and hoisting means supported by at least one of said buoyant members.

13. Marine hoisting equipment of the class described comprising in combination: two buoyant members, struts spacing the buoyant members so that each may roll and pitch independently of the other, an upright member on each buoyant member, means anchoring one of the upright members to its respective buoyant member, means connecting the other upright member to its respective buoyant member for relative turning movement, a strut extending between said upright members, and connecting means between the ends of said strut and said upright members providing for universal tilting movement.

14. Marine hoisting equipment of the class described, comprising in combination: two buoyant members, means spacing the members apart so that each may roll and pitch independently of the other, an upright member on each buoyant member, means pivotally connecting one of the upright members to its respective barge, a strut member extending between the upright members, gimbal means connecting one end of the strut member to one of the upright members, and means connecting the other end of the strut member to the other upright member.

15. Marine hoisting equipment of the class described, comprising in combination: a pair of generally parallel floating barges, strut means near one end of the barges acting to define a working space between them near the other end of the barges, an upright member on each barge, means anchoring one of the upright members to its barge, means pivotally connecting the other upright member to its barge, a strut member extending between the upright members, means at each end of the strut member connecting it for universal movement relative to each of the upright members, means at one end of the strut member permitting relative turning movement of the strut member about its longitudinal axis, and hoisting means including elements supported by the upright members for lifting a load in said working space between the barges.

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