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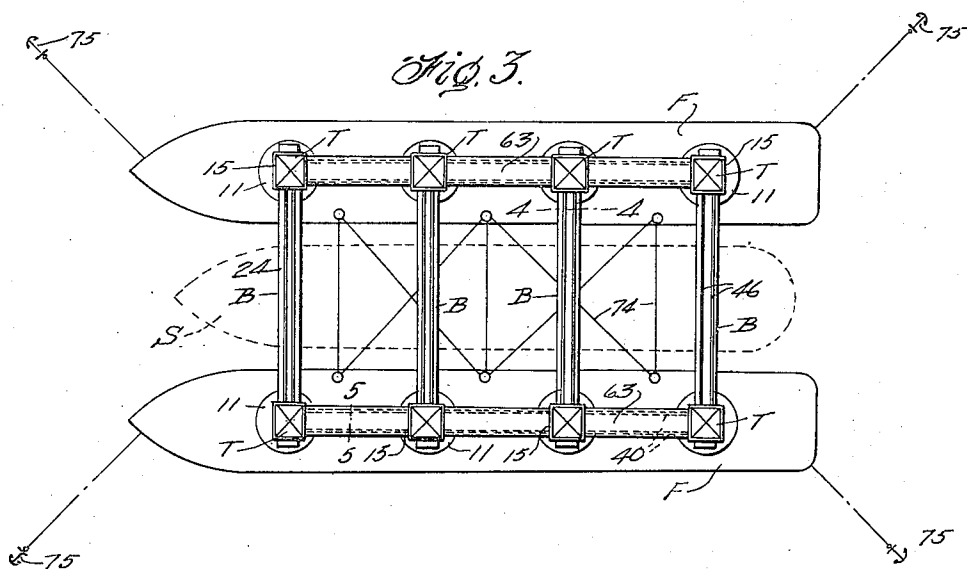
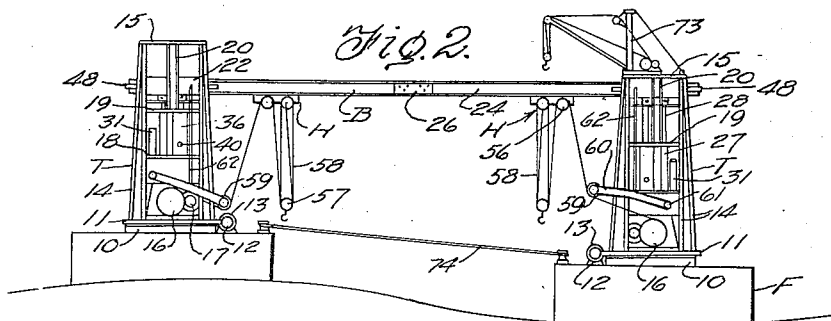
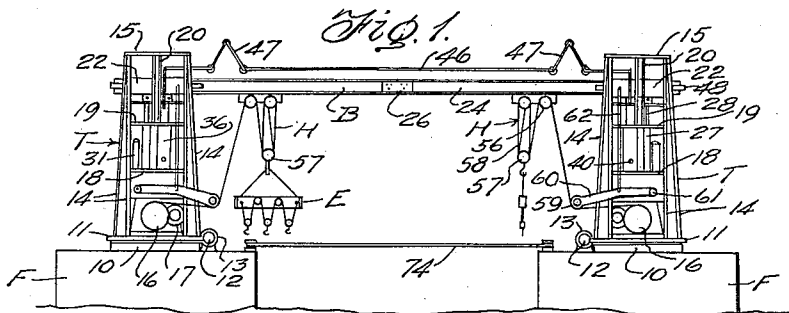
C. M. ZOLL

2,272,785

SHIP SALVAGING APPARATUS

Filed April 23, 1941

4 Sheets-Sheet 1



Inventor

Carl M. Zoll,

By

Clarrison

Attorney

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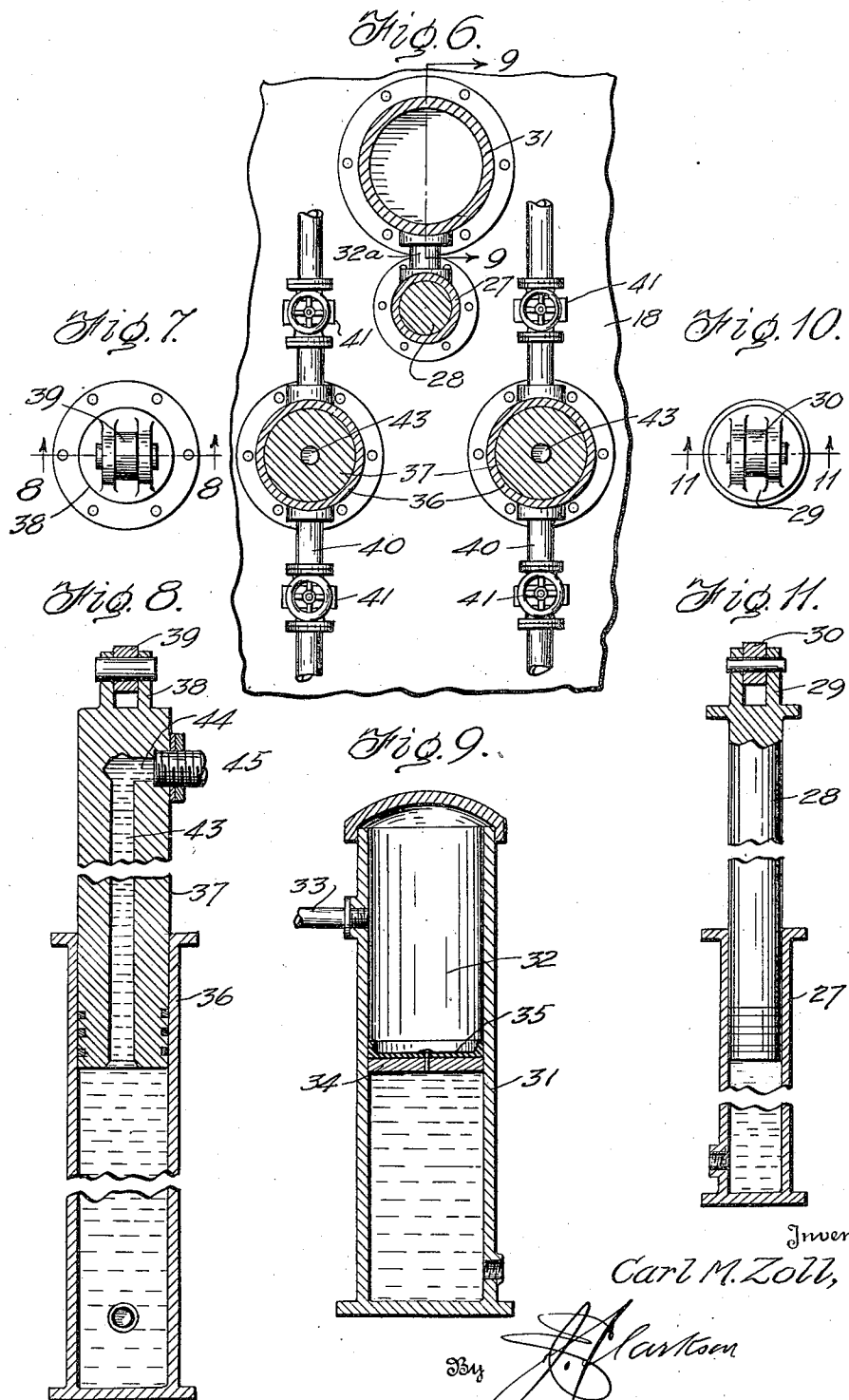
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Fig. 12.

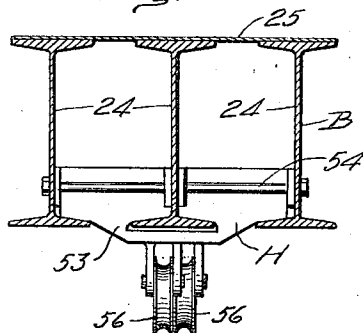


Fig. 13.

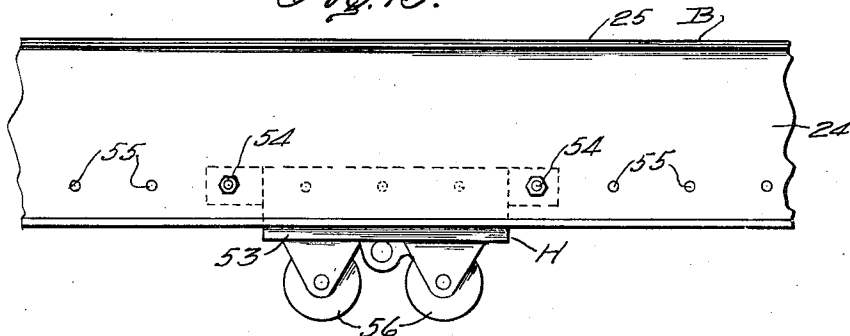


Fig. 14.

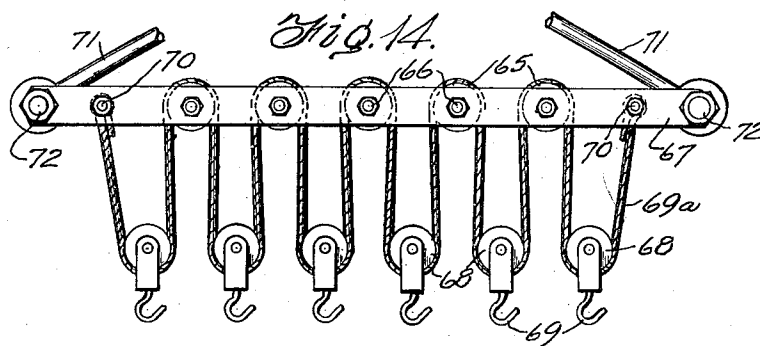
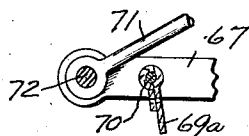


Fig. 15.



Inventor

Carl M. Zoll,

By

A. Carlson

Attorney

UNITED STATES PATENT OFFICE

2,272,785

SHIP SALVAGING APPARATUS

Carl M. Zoll, Dundalk, Md., assignor to Universal
Hydraulic Stress Equalizer, Inc., Dundalk, Md.

Application April 23, 1941, Serial No. 389,974

21 Claims. (Cl. 114—44)

This invention relates to ship salvaging apparatus for raising sunken ships.

It is a common practice in raising sunken vessels to sink water filled pontoons alongside the ship, secure them thereto by chains passed under the ship and blow out the water with compressed air. The buoyancy of the pontoons is then supposed to be utilized to raise the ship. Such a process requires much under-water work on the part of divers in positioning and securing the pontoons in place and it is extremely difficult to so position the pontoons that the sunken ship will rise evenly. In fact experience has shown that one end of such a ship will break free from the bottom while the other end is still held by the mud or sand and the pontoons will slip off the risen end. Further, if the sunken ship be lying on her side it will be practically impossible by this method to restore her to an even keel position so that, even if successful she will be brought to the surface on her side as she lay on the bottom.

One important object of the invention is to provide a novel apparatus whereby a sunken ship may be raised with a minimum of work by divers.

A second important object of the invention is to provide novel salvaging means whereby it will be possible to raise a sunken ship without the employment of pontoons.

A third important object of the invention is to provide a novel salvaging apparatus whereby a sunken ship may be raised on an even keel even though lying on its side in sunken position.

A fourth important object of the invention is to provide a novel salvaging apparatus whereby the hoisting of a sunken ship will not be affected by storms of any ordinary intensity.

A fifth important object of the invention is to provide a novel salvaging apparatus including hoisting means attachable at spaced points on each side of the sunken ship and wherein even and equal stresses will be maintained on all the hoisting means independently of wave action.

A sixth important object of the invention is to provide a novel salvaging apparatus wherein hydraulic means are used to equalize the weight of the sunken ship at various points in its length.

A seventh important object of the invention is to provide such a salvaging apparatus having hoist supporting girders carried by barges or floats and maintained at a uniform position in space independently of weather and sea conditions.

An eighth important object of the invention is to provide a novel apparatus of this class where-

in the apparatus may be readily adjusted for any length and beam measurements of a sunken ship within the upper limit of tonnage and size of ship the apparatus is designed to raise.

5 A ninth important object of the invention is to provide an apparatus of novel construction wherein the major parts may be readily assembled for use and disassembled for movement from one place to another.

10 With the above and other objects in view, the invention consists in general of certain novel details of construction and combinations of parts hereinafter fully described, illustrated in the accompanying drawings and particularly pointed out the appended claims.

15 In the accompanying drawings like characters of reference indicate like parts in the several views, and:

20 Figure 1 is an end elevation to small scale of the complete apparatus with the two barges forming the supports for the remainder of the apparatus at the same level.

25 Figure 2 is a view similar to Figure 1 but with the barges at different levels and certain parts omitted.

Figure 3 is a plan view showing the apparatus in position for raising a sunken vessel, the latter being indicated by broken lines.

30 Figure 4 is an enlarged fragmentary section on the line 4—4 of Figure 3.

Figure 5 is a similar section on the line 5—5 of Figure 3.

Figure 6 is a further enlarged section on the line 6—6 of Figure 4.

35 Figure 7 is a plan view of one of the weight supporting cylinders used in this device.

Figure 8 is a section on the line 8—8 of Figure 7.

40 Figure 9 is a section on the line 9—9 of Figure 6.

Figure 10 is a plan view of one of the balancing cylinders used in this device.

Figure 11 is a section on the line 11—11 of Figure 10.

45 Figure 12 is an enlarged detail section on the line 12—12 of Figure 2.

Figure 13 is a side elevation of the detail shown in Figure 12.

50 Figure 14 is a side elevation of a portion of an equalizer device suitable for use herein.

Figure 15 is a fragmentary section through one end portion of the device shown in Figure 14.

The structure as disclosed in the present drawings includes in general a pair of barges or floats F each carrying a set of tower structures T. The

towers T of one barge are connected to corresponding towers of the other barge by hoisting bridges or girders B.

The barges or floats F are alike in dimensions and each should be at least as long as the vessel which is to be raised. Moreover, these barges have equal load capacities and the combined load capacities of the two are somewhat greater than the weight of the vessel to be raised. The hulls of these barges are of suitable form as to promote stability and limit, as far as possible, all rolling motions of these barges. These barges may be self propelled or they may be moved from place to place by tugs or the like.

The towers T are spaced longitudinally of the respective barge and may be as many as desired from two up. Preferably the spacing between centers of the towers is uniform. All the towers are of like construction and each includes a base 10 whereon is suitably mounted a turntable or platform 11 the periphery of which constitutes a worm gear engaged by a worm 12 actuated by a motor 13. The motor 13 may be of any suitable kind but is preferably an electric motor obtaining its power from a suitable source (not shown) which may be an electric generating plant carried by the barge or may be brought on board through an electric cable from a mother ship. By this means the towers may be rotated if and when desired. Mounted on each platform 11 is a structural steel frame having vertical corner posts and inclined braces indicated as at 14. A square frame 15 holds the uprights and braces in proper relation at the top of each tower. On each platform 11 is a winding drum 16 actuated by a suitable motor 17. Above the winding drum and its motor is a lower tower deck 18 and spaced between the deck 18 and frame 15 is an upper tower deck 19. Between the frame 15 and deck 19 on those sides of the tower which normally constitute the forward and after sides is a pair of vertical guides 20 and between each pair of these guides fits a guide bar 21 fixed on one side of a carriage or housing 22 which may thus slide vertically of the tower. Rollers 23 serve to engage the guides to render easy the up and down movement of the carriage and to prevent jamming of the latter under twisting stresses which may be induced by rocking of the barge. These rollers are omitted from Figures 1 and 2 because of the small scale of those figures.

Each of the bridges or girders B is here shown as consisting of three I-beams 24 but it is to be understood that any desired construction of girder may be used and that the construction will vary both in form and size in accordance with the maximum dimensions and weight of vessel the particular embodiment of this invention is designed to salvage. The beams 24 may be connected to form a unitary girder by any preferred means as here indicated in Figures 12 and 13 at 25. Also these girders may be formed in two or more sections releasably secured together as by fish plates 26. Each girder has one end slidably mounted in the carriage 22 of one tower of a barge and its other end slidably mounted in the carriage 22 of the corresponding tower on the other or second barge. Thus the barges may be adjusted to any suitable distance apart within the limits determined by the lengths of the girders.

It is intended that normally the carriage 22 shall lie, when the weight of the sunken ship S is fully supported on the apparatus by the means presently to be described, about half way be-

tween the frame 15 and upper deck 19 and to the end there is mounted on the deck 18 beneath the central beam 21 a cylinder 27 which extends up to deck 19 and in that deck is an opening so that a plunger 28 tightly fitting the cylinder 27 may extend through this deck. The plunger 28 is provided with a head 29 carrying a roller 30 engaging against the under side of the carriage 22. Also fixed on the deck 18 is a pressure chamber 31 and the lower ends of the cylinders 31 and 27 are connected by a nipple 32a. The lower part of the cylinder 31 constitutes a hydraulic portion, being filled preferably with a suitable oil which also fills all of the cylinder 27 below the plunger 28. The upper part of the cylinder 31 constitutes a compressed air chamber 32, being filled to the desired pressure through a valved pipe 33. While the air in the chamber 32 may exert pressure directly on the oil below it is preferred to interpose a floating piston 34 provided with air tight packing 35 between the oil and air. With the arrangement shown, these pistons equalize the load in case one side of the sunken ship is heavier than the other, the air pressure on the heavier side being greater than that on the lighter side.

Also, on each deck 18 there is provided a pair of stress equalizing cylinders 36 aligned below the lateral beams 24. These cylinders are arranged like the cylinder 27 and are each provided with a piston 37 having a head 38 carrying a roller 39 which engages beneath the carriage 22. Pipes 40 connect the cylinders of the several towers of the barge, each pipe being provided with valves 41 so that any cylinder may be isolated for repairs or if the conditions are such that its use is not necessary or desirable. Each plunger has an oil duct 43 leading from its bottom end to a point adjacent its top where it is provided with a lateral outlet 44 to which is fitted one end of a pipe 45, which leads by suitable bends to a point within the tower and above the girder B. There are thus two pipes 45 for each tower and the pipes of each tower on one barge are connected to the pipes 45 of the corresponding tower on the other barge through transverse pipes 46 provided with flexible or other expansion joints 47 to absorb the variations of the space between the towers caused by rolling or other movement of the barges. By the arrangement of the pipes 40 and 46 the pressure upwardly on the pistons 37 will be equalized under all conditions of operation. For example, if, as shown in Figure 2, the left hand barge is raised by wave motion higher than the right hand barge the rise in the oil level in the left hand cylinders which would take place were the cylinders not connected from one barge to the other is immediately counter-balanced by flow through the pipes 46 so that the levels of the bottoms of the pistons 37 and consequently the bridges or girders will remain at their original levels. The same compensation in level is obtained under pitching of the barges through the pipes 40 and through both sets of pipes under any working conditions of combined pitching and rolling.

In order to overcome or check any variations in the longitudinal positions of the girders in the towers each girder has attached to each side a pair of aligned dash-pot cylinders 48 provided with pistons 49 abutting against a center plate 50 fixed in the carriage 22. These cylinders 48 thus constitute a species of air cushions to resist movement of the girder. In order that the girder may be adjusted when desired the girder is provided

with spaced bolt holes and then secured at adjusted holes by bolts 52.

Adjacent each barge each girder B is provided with a hoist or tackle which is indicated in general in Figures 1 and 2 at H and details of which are more fully shown in Figures 12 and 13. The upper block of this tackle comprises a body member 53 resting on the lower flanges of the beams 24 and secured in desired position by bolts 54 passing through selected ones of the spaced bolt holes. The body 53 supports a plurality of sheaves 56 and the lower block 57 also carries a number of sheaves to suit the number carried by the body 53. The hoisting cable 58 is led around these sheaves and to the winding drum 16. In its passage to the drum the cable is led under an idler sheave 59 carried by a lever 60 which is pivoted to the tower at 61. This lever is connected to the carriage 22 by a rigid link 62 as by suitable pivot connections at each end of the link. The purpose of this arrangement is to prevent undesirable changes in the tension of the hoisting cables. The manner in which this is effected will be best understood by observation of Figure 2. If it were not for this arrangement the lift of the left hand barge, the girder B remaining constantly in position in space, would shorten the distance between the winding drum 16 and upper block with a consequent slackening of the cable. However, the lift of the barge causes the lever 60 to swing down with respect to the drum 16 and the action of the idler thus takes up the slack. Similarly the drop of the right hand barge increases the distance between the drum 16 and upper block, but the lever 60 swings up at the same time and thus lessens the angularity of the parts of the cable at opposite sides of the idler and, in effect, lengthens the cable in accordance with the drop.

The towers on each barge may be connected by overhead bridges 63 removably supported on brackets 64 carried by the towers.

It may, in some cases be desired to spread the supporting area along the length of the sunken ship at one or more towers and to that end an equalizer E may be hung from a lower block 57. One such equalizer is shown in Figures 14 and 15. In this form a row of upper sheaves 65 are carried by bolts 66 which extend between bars 67. Lower blocks 68 carrying hooks 69 are arranged below these bars and a cable 69a is led over these upper and lower sheaves and anchored to bolts 70. A yoke bar 71 of inverted V-shape has its ends secured by bolts 72.

In order to facilitate assembling and disassembling of the girders in relation to the towers an ordinary jib crane 73 may be mounted on each tower by which the girder sections may be separated and each section withdrawn from its tower and lowered onto the deck of the barge or the barges may be moved apart, while the cranes support the girder ends, until these ends are clear of the towers when the barges may be moved together and the entire girder swung around to lie on the deck of one barge. Alternatively, the girders may be separated into two sections and run in until the sections have their central portions supported in the towers and the towers rotated after the bridges 63 are removed and stored on deck.

In raising a ship the girders may be assembled in the towers while the barges are in port and cables used to connect the barges which may then be towed as a unit into position to straddle the sunken ship S and there moored by anchors

as indicated at 75. In another manner of positioning the barges they may be moved individually into position, connected by the cables 74 and moored. The girders are then assembled with the towers. When the barges are in position the hoists or tackles are attached to the sunken ship, by divers if the ship is entirely submerged. The hoisting drums are then manipulated to take up the slack on the cables. The air chambers having been charged to the desired pressure, to equalize possible difference in weight of the two sides of the ship, the bridges will be in proper normal height and the hoisting of the sunken ship may proceed. When the ship has been raised to a desired height the repair work may proceed to enable the ship to be pumped out and floated, such repairs and pumping taking place where the ship was sunk or the barges and suspended ship may be moved bodily to any convenient place for such work. If the superstructure of the sunken ship is, when the latter is raised, in danger of fouling the bridges the amount of fluid in cylinders 36 may be increased whereupon the bridges may be moved toward the tops of the towers by the upward movement of pistons 37 to maximum height.

What is claimed, is:

1. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, and leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means.

2. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, and leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements.

3. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, and leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements and other piping connecting all the pressure elements at like ends of the girders in series.

4. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, and pneumohydraulic weight compensating means carried by the floatation means and supporting the

floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, hoisting drums on the floatation means each having a respective hoisting means connected thereto, and compensating means acting on the connections between the drums and hoisting means and compensating variations in distances between the floatation means and girders caused by wave motion and the like, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements and other piping connecting all the pressure elements at like ends of the girders in series.

5 maintaining the girders at constant heights
above the horizon of a body of water supporting
said floatation means independently of vertical
movements of the floatation means, hoisting
drums on the floatation means each having a
10 respective hoisting means connected thereto,
and compensating means acting on the connections
between the drums and hoisting means
and compensating variations in distances be-
tween the floatation means and girders caused
15 by wave motion and the like, said leveling means
including hydraulic pressure elements support-
ing each end of the respective girders and pip-
ing connecting the pressure elements and other
piping connecting all the pressure elements at
20 like ends of the girders in series.

20 like ends of the girders in section.

10. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, pneumohydraulic weight 30 compensating means carried by the floatation means and supporting the ends of the girders to compensate the extent of weight supported by the respective girders, hoisting drums on the floatation means each having a respective hoisting means connected thereto, and compensating 35 means acting on the connections between the drums and hoisting means and compensating variations in distances between the floatation means and girders caused by wave motion and the like.

40

11. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, pneumohydraulic weight compensating means carried by the floatation means and supporting the ends of the girders to compensate the extent of weight supported by the respective girders, hoisting drums on the floatation means each having a respective hoisting means connected thereto, and compensating means acting on the connections between the drums and hoisting means and compensating variations in distances between the floatation means and girders caused by wave motion and the like, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements.

12. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of the body of water supporting said floatation means independently of vertical movements of the floatation means, pneumohydraulic weight compensating means carried by the floatation means and supporting the ends of the girders to compensate the extent of weight supported

9. In a ship salvaging apparatus, spaced 75

by the respective girders, hoisting drums on the floatation means each having a respective hoisting means connected thereto, and compensating means acting on the connections between the drums and hoisting means and compensating variations in distances between the floatation means and girders caused by wave motion and the like, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements and other piping connecting all the pressure elements at like ends of the girders in series.

13. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, and motion limiting and checking means interposed between end portions of each girder and the floatation means and arranged to permit resisted and limited longitudinal girder movement with respect to the floatation means.

14. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, and motion limiting and checking means interposed between end portions of each girder and the floatation means and arranged to permit resisted and limited longitudinal girder movement with respect to the floatation means, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements.

15. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, and motion limiting and checking means interposed between end portions of each girder and the floatation means and arranged to permit resisted and limited longitudinal girder movement with respect to the floatation means, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements and other piping connecting all the pressure elements at like ends of the girders in series.

16. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, pneumo-hydraulic weight compensating means carried by the floatation means and supporting the ends of the girders to compensate the extent of weight supported

by the respective girders, and motion limiting and checking means interposed between end portions of each girder and the floatation means and arranged to permit resisted and limited longitudinal girder movement with respect to the floatation means.

17. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, pneumo-hydraulic weight compensating means carried by the floatation means and supporting the ends of the girders to compensate the extent of weight supported by the respective girders, and motion limiting and checking means interposed between end portions of each girder and the floatation means and arranged to permit resisted and limited longitudinal girder movement with respect to the floatation means, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements.

18. In a ship salvaging apparatus, spaced floatation means, elevated girders spanning the space between the floatation means, ship hoisting means carried by said girders, leveling means supported from the floatation means and maintaining the girders at constant heights above the horizon of a body of water supporting said floatation means independently of vertical movements of the floatation means, pneumo-hydraulic weight compensating means carried by the floatation means and supporting the ends of the girders to compensate the extent of weight supported by the respective girders, and motion limiting and checking means interposed between end portions of each girder and the floatation means and arranged to permit resisted and limited longitudinal girder movement with respect to the floatation means, said leveling means including hydraulic pressure elements supporting each end of the respective girders and piping connecting the pressure elements and other piping connecting all the pressure elements at like ends of the girders in series.

19. In a ship salvaging device, a spaced pair of like barges, a series of spaced towers supported on each barge, carriages each slidably mounted for vertical movement in a respective tower, hydraulic means carried by said towers and supporting said carriages, girders each having one end supported in the carriage of a respective tower of one barge and its other end supported in the carriage of the corresponding tower of the other barge, hoisting means carried by said girders and operated from said towers, and piping connecting certain of the hydraulic means of one barge with corresponding hydraulic means of the other barge and connecting the said certain means of each barge in series.

20. In a ship salvaging device, a spaced pair of like barges, a series of spaced towers supported on each barge carriages each slidably mounted for vertical movement in a respective tower, hydraulic means carried by said towers and supporting said carriages, girders each having one end supported in the carriage of a respective tower of one barge and its other end supported in the carriage of the corresponding tower of the

other barge, hoisting means carried by said girders and operated from said towers, piping connecting certain of the hydraulic means of one barge with corresponding hydraulic means of the other barge and connecting the said certain means of each barge in series, and means to rotate said towers on their vertical axes.

21. In a ship salvaging device, a spaced pair of like barges, a series of spaced towers supported on each barge, carriages each slidably mounted for vertical movement in a respective tower, hydraulic means carried by said towers and supporting said carriages, girders each having one end supported in the carriage of a respective tower of one barge and its other end supported

in the carriage of the corresponding tower of the other barge, hoisting means carried by said girders and operated from said towers, and piping connecting certain of the hydraulic means of one barge with corresponding hydraulic means of the other barge and connecting the said certain means of each barge in series, said hydraulic means including cylinders receiving fluid under pressure and plungers supporting said girders, the normal quantity of fluid supporting the girders in midmost position of vertical movement and the cylinders being adapted to receive additional fluid for moving the girders to maximum position of height in the towers.

CARL M. ZOLL.