Dec. 7, 1943. C. M. ZOLL 2,336,148

APPARATUS FOR SALVAGING SHIPS

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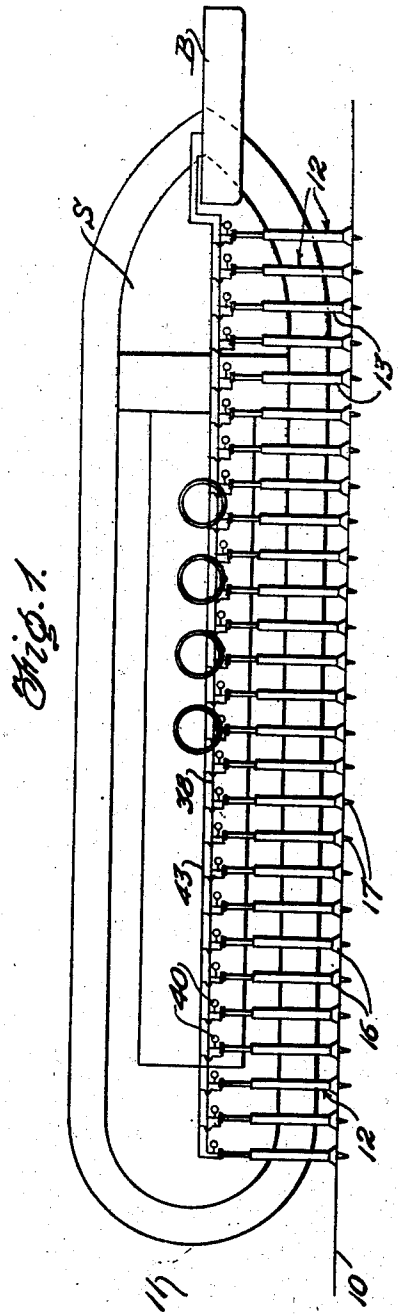



Fig. 1.

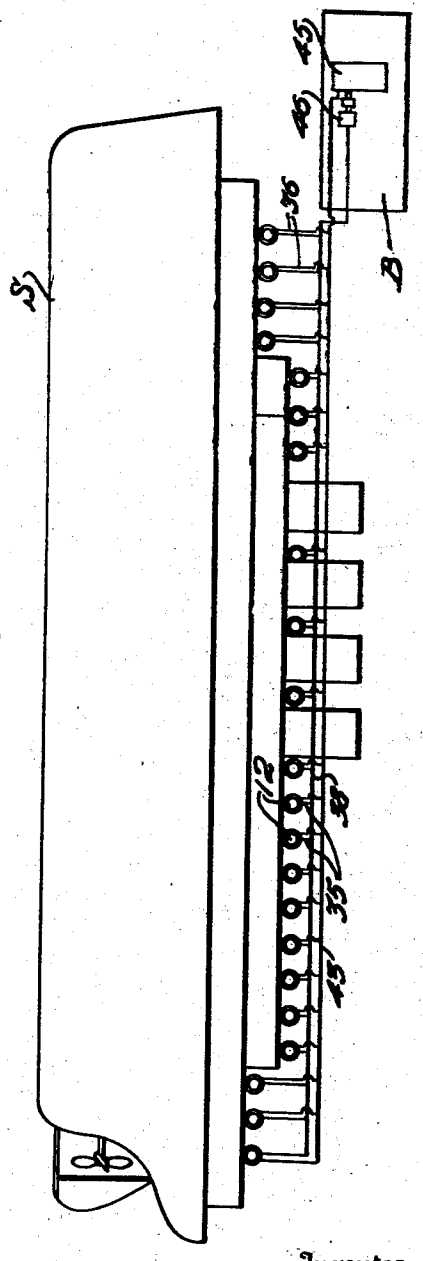



Fig. 2.

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Dec. 7, 1943. C. M. ZOLL 2,336,148

APPARATUS FOR SALVAGING SHIPS

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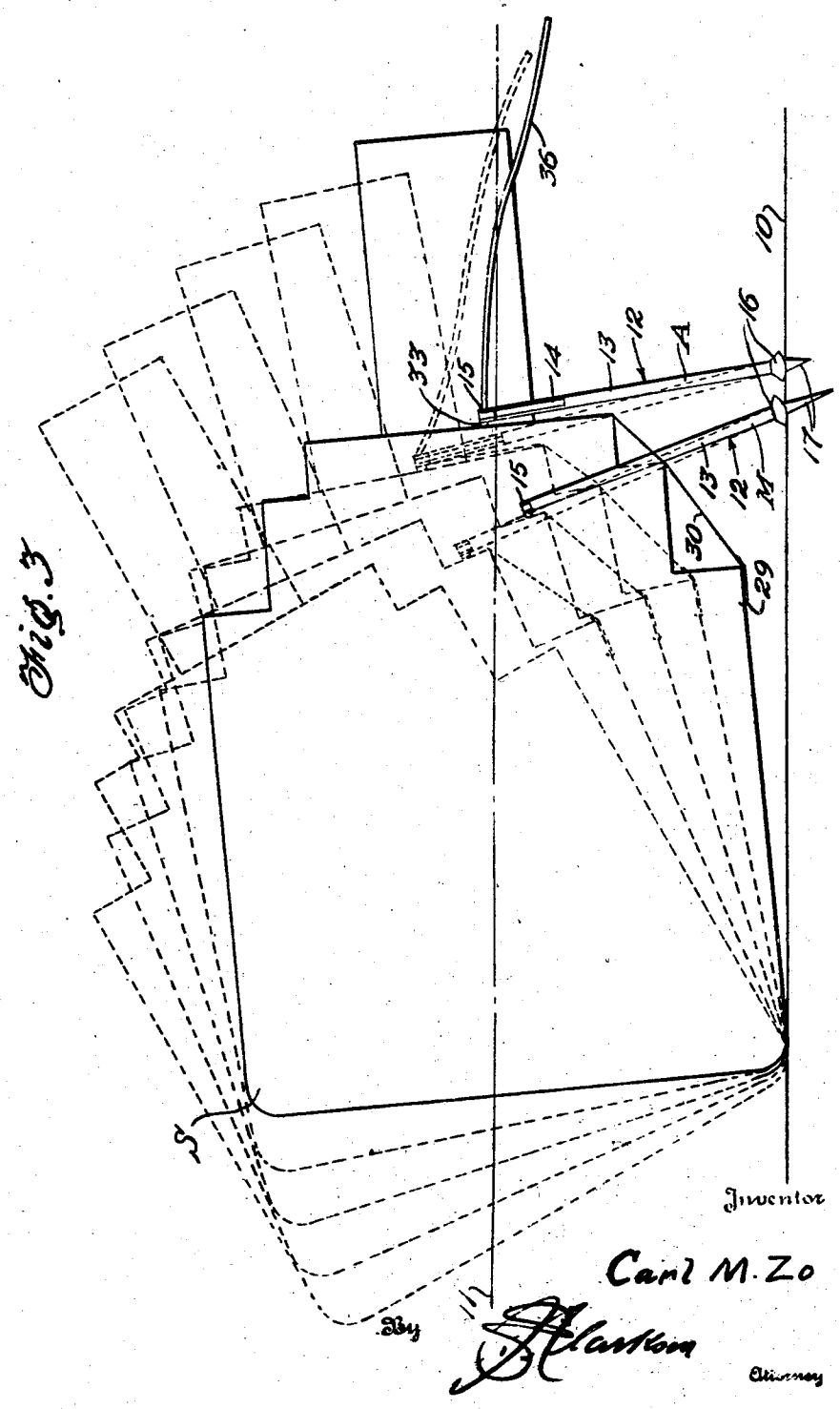


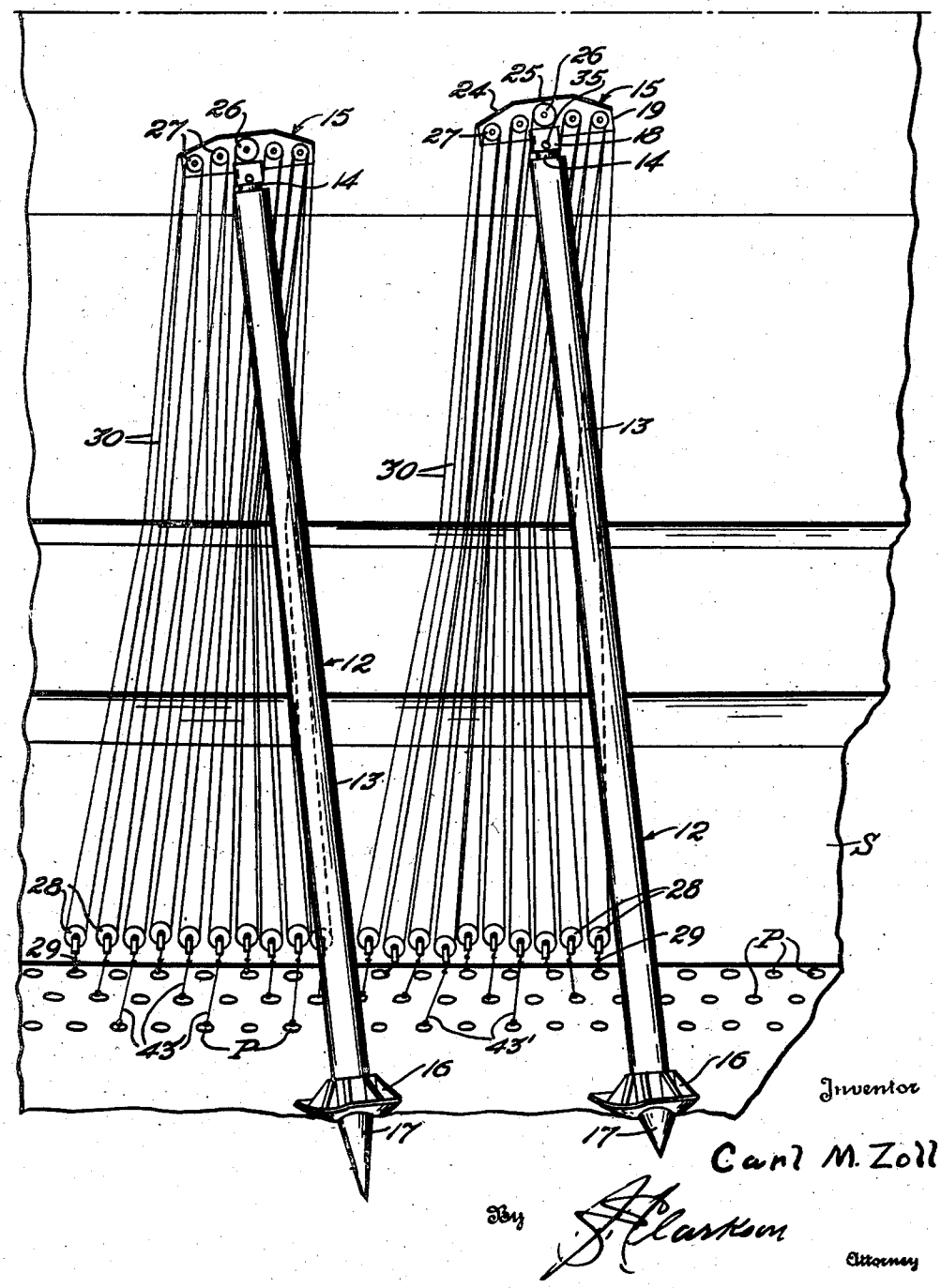

Fig. 3

Dec. 7, 1943. C. M. ZOLL 2,336,148

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Fig. 4.




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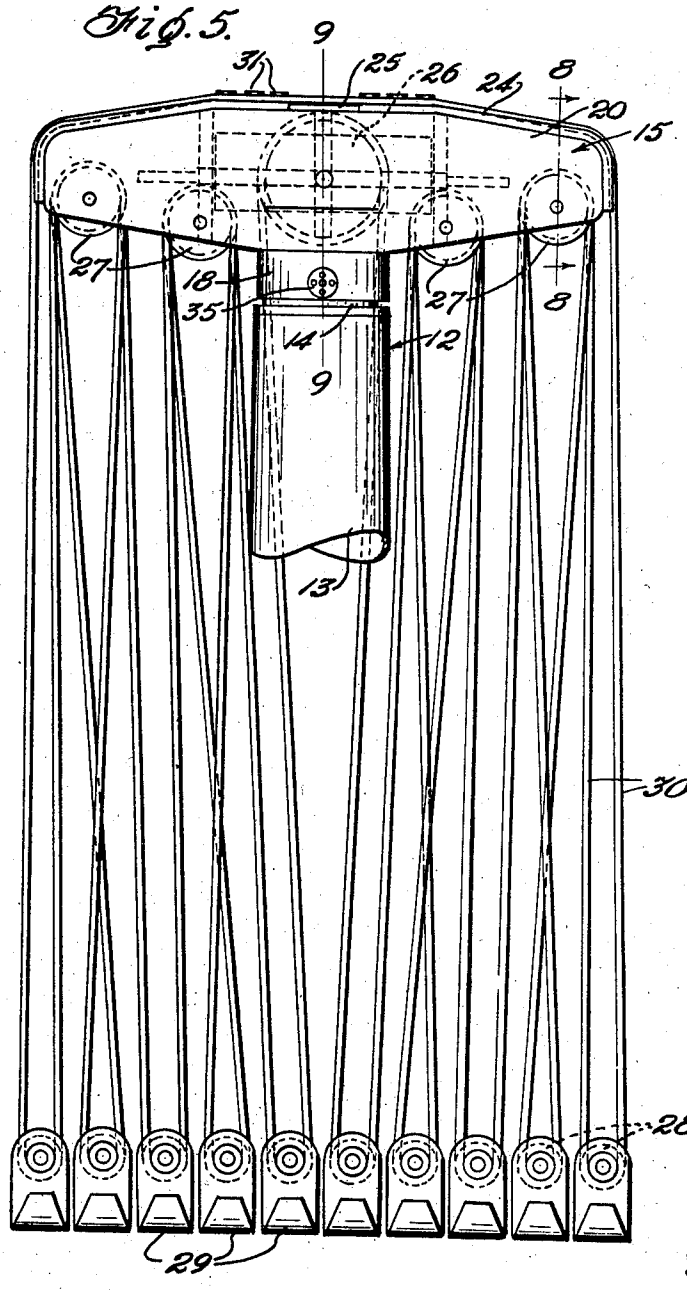
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Dec. 7, 1943. C. M. ZOLL 2,336,148

APPARATUS FOR SALVAGING SHIPS

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Fig. 5.




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Fig. 6.

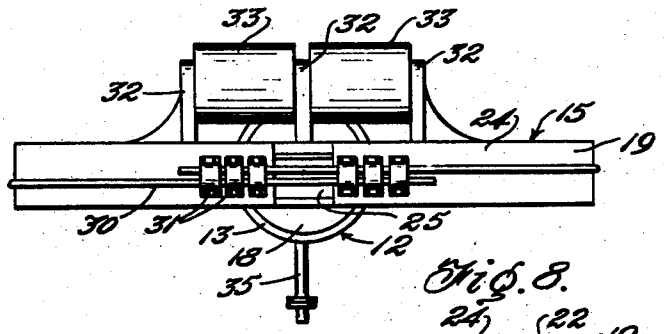



Fig. 8.

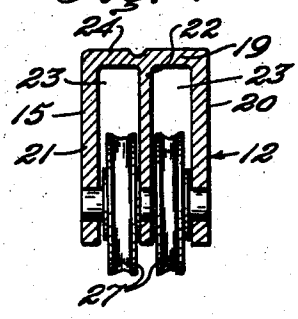



Fig. 7.

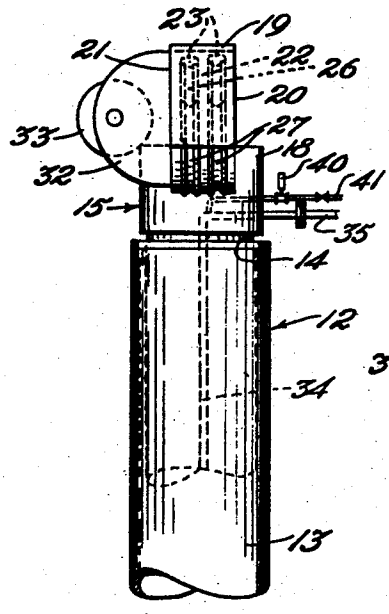
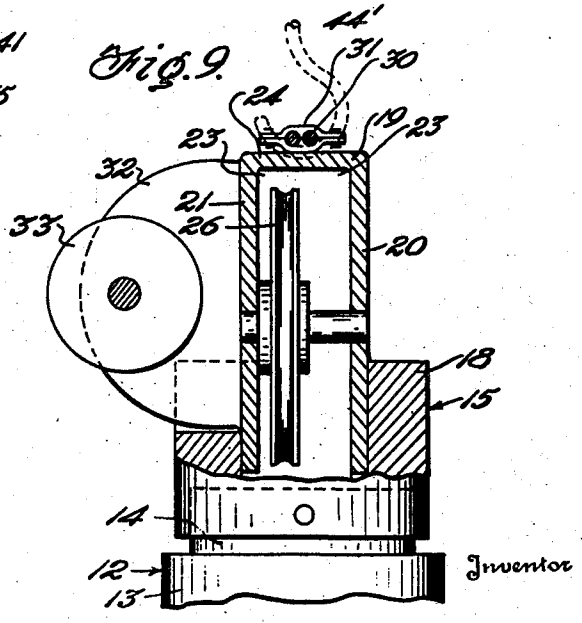



Fig. 9.




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APPARATUS FOR SALVAGING SHIPS

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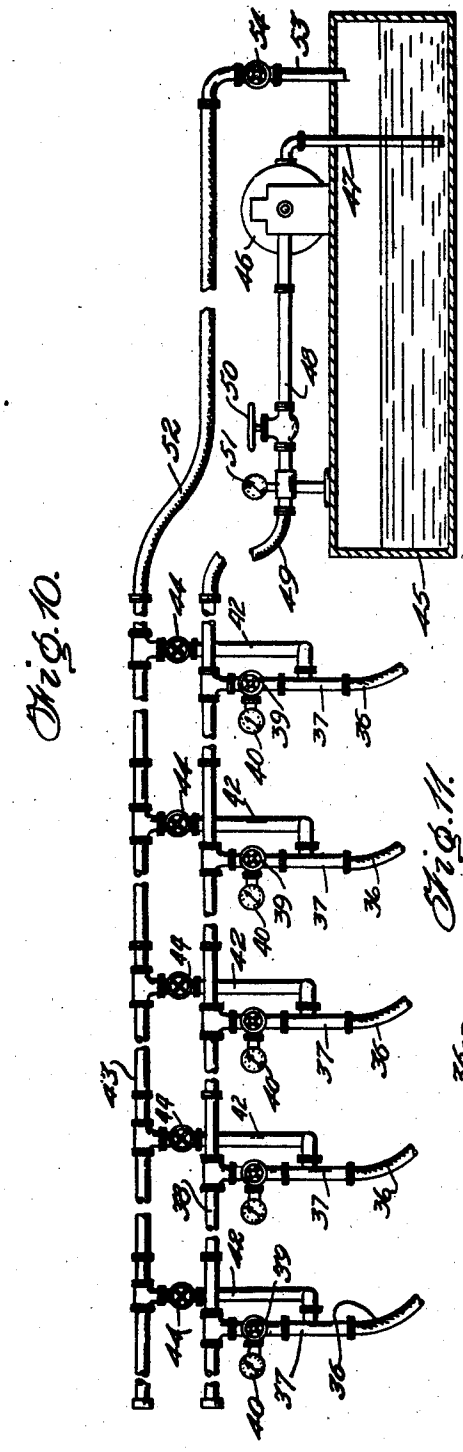


Fig. 10.

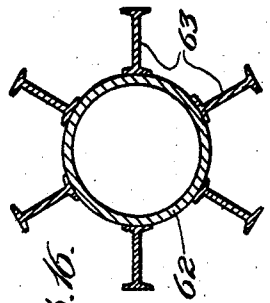


Fig. 16.

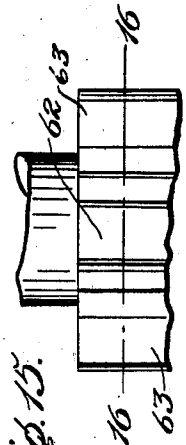


Fig. 15.

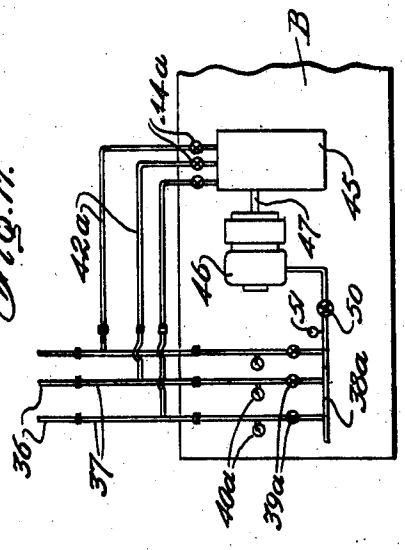


Fig. 11.

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APPARATUS FOR SALVAGING SHIPS

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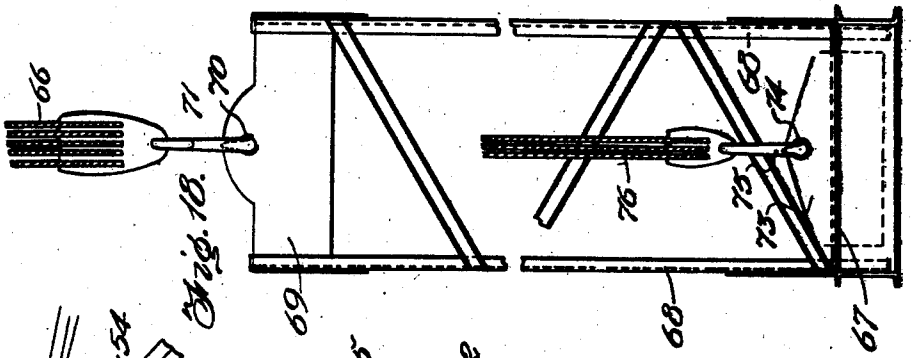



Fig. 18.

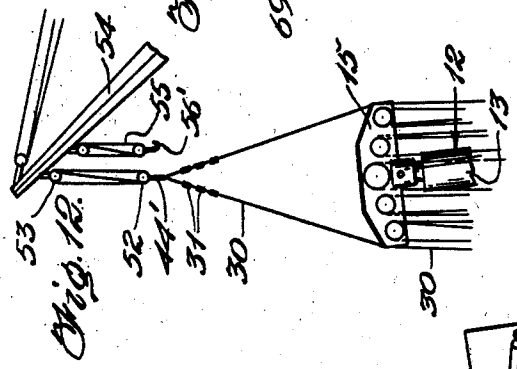



Fig. 12.

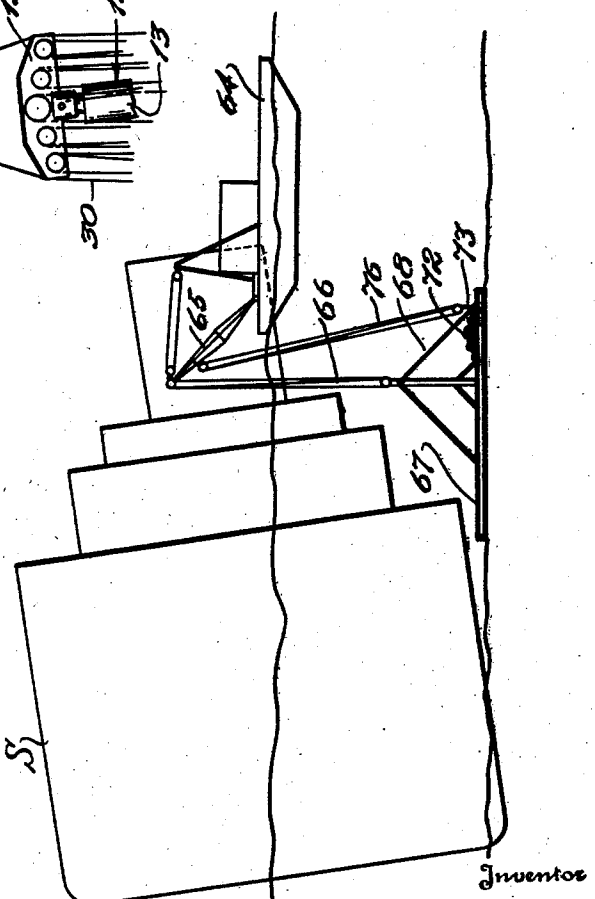



Fig. 17.

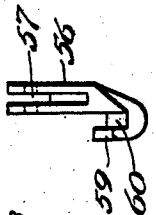



Fig. 14.

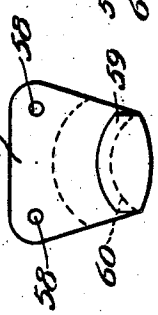



Fig. 13.

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Patented Dec. 7, 1943

2,336,148

# UNITED STATES PATENT OFFICE

2,336,148

## APPARATUS FOR SALVAGING SHIPS

Carl M. Zoll, Dundalk, Md.

Application March 30, 1942, Serial No. 436,877

8 Claims. (Cl. 114—44)

This invention relates to the salvaging of ships and especially to righting sunken ships from beam-end positions.

It frequently happens that ships sink and roll over so that the sunken ship lies on its side and thus is in beam-end position. Such sinkings often occur in quite shallow waters as in docks or harbors. For instance, a ship in a dock may catch fire and be flooded with water to extinguish the fire and when sufficient water has entered such a ship it will sink. Unless the bottom of the dock is unusually level, the ship will heel or list and even a slight heeling of the ship will result disastrously since, as soon as the heeling begins, the water in the ship will flow to the lower side, cause further heeling and finally the ship will roll over on its side. In such a beam-end position any attempt to raise the ship by closing all openings and pumping out the water will, in almost every instance, cause the ship to roll still further over until finally, when she floats, she will float bottom up. Pontoons have been attempted to be used where room exists around such a ship but in case the ship lies in a dock or slip there is no room for pontoons. Moreover, even if the conditions are such as to afford room for pontoons, the difficulties of using these devices are great and they cannot be accurately controlled so that their use is apt to roll the ship from one side to the other.

The principal object of the present invention is to provide a practically simple and highly efficient method and means for righting ships from beam-end positions, the means being positively controllable.

A second important object of the invention is to provide a novel arrangement of hydraulic jack and lifting tackle whereby a lifting motion constituting a multiple of the stroke of the jack may be accomplished.

A third important object of the invention is to provide a novel arrangement of hydraulic lift and tackle wherein the tackle connects the jack to the sunken ship in such manner that each stroke of the jack will lift the ship a distance equal to the stroke made by the jack.

A fourth object of the invention is to provide a novel form of lifting tackle for connecting a hydraulic jack to a ship whereby the stress exerted by the jack will be exerted on the ship at a series of spaced points thus avoiding concentration of such stress at a single point on the ship.

A fifth important object of the invention is to provide a tackle for the foregoing purpose wherein the stresses exerted by the tackle at the several points at which it is connected to the ship will be equalized.

With the above and other objects in view, the invention consists in general of an apparatus having a novel arrangement of elements and combination of parts hereinafter fully described, illustrated in the accompanying drawings and particularly claimed and also of a method having a novel arrangement of steps likewise hereinafter fully described and claimed.

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

Figure 1 is an elevational view of a sunken ship lying on her beam-ends, the view diagrammatically illustrating the apparatus of the present invention.

Figure 2 is a plan view of the arrangement shown in Figure 1.

Figure 3 is a diagrammatic view showing successive steps in the righting of a sunken ship, the initial position of the sunken ship being shown in full lines and the several steps disclosed being shown in broken lines.

Figure 4 is an enlarged view of a portion of Figure 1 showing the lifting apparatus in greater detail.

Figure 5 is a detail view of part of one of the lifting devices used in this invention, the view being on a greatly enlarged scale.

Figure 6 is a plan view of the device shown in Figure 5.

Figure 7 is a side view of the upper part of Figure 5.

Figure 8 is an enlarged section on the line 8—8 of Figure 5.

Figure 9 is an enlarged section on the line 9—9 of Figure 5.

Figure 10 is a view showing an arrangement for actuating and controlling the several jacks used herein.

Figure 11 is a diagram showing a modification of the means for controlling the jacks.

Figure 12 is a fragmentary detail elevation showing the manner in which certain stress equalizing tackle may be adjusted for length.

Figure 13 is a front view of a form of hook adapted to engage in a ship's porthole when operating this invention.

Figure 14 is a side view of the hook shown in Figure 13.

Figure 15 is a fragmentary view of a modified form of hydraulic cylinder used herein under certain conditions.

Figure 16 is a section on the line 16—16 of Figure 15.

Figure 17 is a side elevation of a diver's platform for use in connection with this invention, the view showing the manner in which this platform is used in connection with a sunken ship which has heeled over.

Figure 18 is an enlarged view from in front of such a diver's platform, the better to show the construction.

In the invention as here illustrated a sunken ship is shown at S and rows of port-holes P are shown in the side of this ship. The ship is illustrated as resting on the bottom 10 of a slip or dock wherein the water lever is indicated at 11.

Spaced along the ship are the jacks indicated in general at 12. Each of these jacks has a cylinder 13 in which fits a plunger 14, the upper end of which projects at all times above the top of the cylinder and carries a head indicated in general at 15. At the bottom of each cylinder is a flange or collar 16 of considerably greater diameter than the cylinder and extending downwardly from and axially of each cylinder is an elongated spike or spur 17. This spike is intended to engage rock or other hard part of the bed below the bottom of the body of water in which the ship lies. The flange 16 is also used to support the jack by resting on the mud, sand or other bottom structure into which the spike 17 has penetrated.

Each head 15 includes a lower cylindrical part 18 and an upper laterally elongated housing 19 having a front wall 20, a rear wall 21 and an intermediate partition 22, these walls and partition providing a pair of downwardly open channels 23. The top 24 of the housing has a centrally disposed gap 25 and this top wall curves to merge into the ends of the top 19 and thus forms a saddle. In the central portion of the channels 23 is mounted a sheave 26 and in each end portion of these channels is mounted a plurality of sheaves 27 arranged in axially aligned pairs. For each jack there is provided a set of lower sheaves 28 each carrying a hook or other ship hull engaging means 29. The number of sheaves 28 equals the added numbers of sheaves 26 and 27. A rope 30 has its ends overlapped on top of the saddle and there secured by suitable releasable clamping means 31. The rope 30 extends down from one end of the saddle, passes alternately under the sheaves 28 and over the sheaves 27 and 26, and finally passes up at the other end of the saddle to the clamping means. This construction provided stress equalizing means so that when the hooks 29 are engaged with or connected to the ship and the head 15 raised by actuation of the jack the pulls on the several hooks will be of equal magnitude. Furthermore, by releasing the clamps the effective length of the rope 30 may be changed and thus the average of the distances of the lower sheaves from the head 15 may be varied at the will of the operator. From the head wall 21 extends rearwardly a set of brackets 32 between which are mounted rollers 33.

Each head portion 18 and the corresponding plunger 13 is provided with a fluid conduit or passage 34 to which is connected a supply and exhaust pipe 35 which leads through a flexible hose 36 to a T fitting 37 connected to a supply main 38 through a pipe controlled by a valve 39. A pressure gauge 40 may be connected at this point or to a valved bleeder pipe 41 as shown in Figure 7, the bleeder connects to the passage 34. The fitting 37 also has a pipe 42 leading from it to an exhaust or return pipe 43 and flow through the pipe 42 is controlled by a valve 44. In setting up the device for operation the supply pipe 38 and exhaust pipes 43 may be attached to the side of the sunken ship or supported in any suitable manner in proximity thereto. A flexible connection 36 connects the supply and exhaust pipes to the jack 12. At 45 is a fluid reservoir or tank which may be mounted on an adjacent dock or barge and associated with this tank is a pressure pump typically shown at 46. A suction pipe 47 leads to the pump 45 from a point near the bottom of the tank 45 and a delivery or supply pipe 48 leads from the pump and is connected by flexible hose or tubing 49 to the supply main 38. This pipe 48 carries a main control valve 50 and a main pressure gauge 51. From the return pipe or main 43 leads a flexible hose or tube 52 which is connected to a pipe 53 leading to the upper part of the tank 45 and provided with a main return control valve 54.

In the form shown in Figure 11 the various valves and gauges are shown as concentrated at a central point, as on a barge B. Here the flexible pipes 36 are shown as connected each to a T pipe or fitting 37*a* and these fittings are connected to a supply main 38*a* carried on the barge. Valves 39*a* and gauges 40*a* are provided as before to control flow from the main 38*a*. Return or exhaust pipes 42*a* controlled by valves 44*a* lead from the T pipes 37*a* directly to the tank 45. The operation of these two forms is identical and only the operation of the first described form will be here given since, merely by affixing *a* to each reference character, the operation may be read on the form shown in Figure 11.

In operation a series of the jacks 12 are erected alongside the upper works of the sunken ship at spaced points therealong with the plungers in retracted positions and with the rollers 33 resting against the ship, the jacks being inclined toward the ship. The pipes 36 are now connected to the jacks and the hooks 29 engaged with the ship either directly or by the intervention of links as at 43' in Figure 4 where links lead to the port-holes P. The lengths of the ropes 30 are adjusted so as to take up the slack in these ropes or cables and the latter are clamped in adjusted positions. The valves 44 being closed and the valves 39 open, the pump 46 is started. This produces pressure in the header 38 and fluid from this header is forced to the respective jacks thus producing equal pressures in all of said jacks. The pump is kept in operation until the plungers have reached their maximum or desired extents of protrusion whereupon the pump is stopped. This causes the upper works of the ship to be raised and the start of this step of action of the jacks is indicated by the full line position of jacks A while the finish of the step is indicated by the broken line position of that jack. The valves 39 are now closed. Next one or two of the valves 44 are opened. This, of course, relieves the pressures on the jacks controlled by the opened valves while the remainder of the jacks carry the load. Next, the lapping portion of the rope of one of the idle jacks is engaged, as at 44' in Figure 9, by the hook of any suitable hoisting apparatus and this lapping portion is raised. The effect of this is to exert such tension on the engaged rope 30 as to draw the head 15 downward toward the ship engaged hooks 29 and thus to cause retraction of the

plunger of the jack. The clamps 31 are then released and the rope drawn taut over the housing 18 and again clamped. If more than one valve 44 has been opened the remainder of the jacks controlled by such open valves are collapsed in like manner. The valves 44 controlling the readjusted jacks are now closed and the valves 39 for these jacks are opened while the pump is run to equalize the pressure in the readjusted jacks with that in the other jacks as can be done by watching the gauges 40. The valves 39 of the readjusted jacks are now closed. Successive sets of one or more jacks are treated in like manner until all the jacks have been adjusted to collapsed position and carry the load uniformly distributed. The pump is again started and all valves 39 are opened so as to produce a second lift of the jacks and this series of operations is repeated for each step in righting the ship. In order to get a better purchase for the connections to the ship the jacks may be moved from time to time as indicated at 17 in Figure 3. Care must be taken to stop the action of the jacks somewhat before the ship reaches an even keel position as otherwise the ship may roll over onto her opposite side. When the ship is nearly in even keel position all underwater openings through which water may flow into the ship are closed or bulkheaded off so that no more water can enter the ship at these points. Suitable suction pumps are now used to free the ship from the contained water and, as she lightens, she will rise and assume her proper even keel position. Obviously, when the ship has approached her erect or even keel position jacks such as have been described above may be used at the side of the ship which was, at the start of operations, uppermost so as to prevent any possibility of the ship rolling over with the previous upper side resting on the bottom. In order to prevent fore and aft movement of the ship during the righting operation she should be securely moored against such movements.

While various means may be employed to shorten the cable or rope 30 as above described one preferred form of device for this purpose is shown in Figure 12. Here the hook 44' is shown as forming part of the lower block 52 of a tackle having an upper block 53 depending from the jib or boom 54 of an ordinary jib crane. Also hung from the jib 54 is a second tackle 55 the lower block of which carries a hook 56'. The view shows the hook 44' engaged with the rope 30 and the bight of the rope hauled up. While the rope is in this position the hook 56' is lowered and engaged by a chain hitch, stopper hitch, clamps or other suitable means with the rope 30 at each side of the head 15. The tackle 55 is then hauled taut whereupon the other tackle may be slackened, the hook 44' disengaged from the rope 30, the clamps 31 loosened and the rope ends overlapped as far as possible on the head 15. The clamps are again set up and the device is ready for a further expansion of the hydraulic jack. Obviously, if enough of the rope cannot be taken up by one lift of the bight of the rope 30 repeated adjustments may be made in like manner.

A special form of hook to be used in place of hook 29 is shown in Figures 13 and 14. This form is designed to engage in the port hole of a sunken ship. This comprises a body or back 58 slotted as at 57 to receive a plate for connection to a lower block of the stress equalizer arrangement, rivet or bolt holes 58 being provided for securing the hook to the plate. The hook has a lip or bill 59 spaced from the back and parallel thereto, the connection between the bill and back having a convexly arcuate upper surface 60. Also the upper edge 61 of the bill is convexly arcuate and thus the surface 60 substantially conforms to the curvature of the port hole when the hook is engaged therein.

In some instances it is necessary to have the cylinder 13 of the jack of such a length in proportion to its diameter that, considering this cylinder as a column, the ratio becomes too great to ensure against crippling by bending. In Figures 15 and 16 a modification of the cylinder is shown. In this form the cylinder 62 is provided with longitudinally extending ribs 63 spaced around the cylinder and these ribs are preferably of I-beam form welded securely to the exterior of the cylinders.

When a sunken ship lies substantially or her beam ends as shown in Figure 17 it is very difficult for a diver to manipulate the heavy blocks and hooks to connect the stress equalizers to the ship. In order to afford the diver solid and even footing at the bottom of the water beneath the ship there has been provided a special apparatus as illustrated in Figures 17 and 18. As here shown there is provided a barge or float 64 carrying a crane 65 from which depends a tackle 66. A diver's platform 67 has, adjacent on end, a pair of upstanding frames 68 of inverted V-shape construction. At their upper ends these frames are connected by a transverse member 69 having a centrally disposed opening 70 for the reception of the hook 71 of the tackle. Being thus supported closer to one end, preferably termed the rear end, the other or front end tends to tilt downwardly but this tendency is overcome by suitable weights or ballast 72 placed on the rear end of the platform, the platform thus having a cantilever support or suspension. Since the suspension is remote from the front end of the platform a diver may conveniently work on this front end and the front end may, as shown in Figure 17, be readily introduced beneath the ship S. In order to prevent a see-saw action of the platform it is preferably somewhat overweighted at its rear end and a plate 73 rises from the rear end and is provided with an opening 74 for reception of the hook 75 of a tackle 76 having its upper end attached to the crane. Thus, the platform is held against unwarranted tilting but when it is desired to effect tilting, as for introducing the front end beneath a ship, this may be done by properly manipulating the tackles 66 and 76.

What is claimed, is:

1. In apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, means to secure the ends of said cable together, and hull engaging rollers carried by said transverse head.

2. In apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, means to secure the ends of said cable together, said last means including clamps ar-

ranged to permit adjustment of the length of said cable, and hull engaging rollers carried by said transverse head.

3. In apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, means to secure the ends of said cable together, each of said lower pulleys being provided with ship hull engaging means, and hull engaging rollers carried by said transverse head.

4. In apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, means to secure the ends of said cable together, said last means including clamps arranged to permit adjustment of the length of said cable, each of said lower pulleys being provided with ship hull engaging means, and hull engaging rollers carried by said transverse head.

5. In apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, the end portions of said cable passing around the end pulleys of the lower series up and over the head and overlapping at the center of the head, detachable clamps securing said end portions together to form a substantially endless cable and hull engaging rollers carried by said transverse head.

6. In an apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, and means to secure the ends of said cable together, the top of said head having a centrally disposed gap permitting engagement of the joined ends of said cable by a hoisting hook.

7. In apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, the end portions of said cable passing around the end pulleys of the lower series up and over the head and overlapping at the center of the head, and detachable clamps securing said end portions together to form a substantially endless cable, the top of said head having a centrally disposed gap permitting engagement of the joined ends of said cable by a hoisting hook.

8. In apparatus for righting a sunken ship, a hydraulic jack having a cylinder and a plunger, means to supply said jack with fluid under pressure, a transverse head on said plunger, pulleys spaced along said head, a series of laterally spaced lower pulleys, a cable passing alternately over the upper and under the lower pulleys, means to secure the ends of said cable together, and hull engaging rollers carried by said transverse head, the top of said head having a centrally disposed gap permitting engagement of the joined ends of said cable by a hoisting hook.

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