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1,495,529

J. W. RENO

RAISING SUNKEN SHIPS

Filed Aug. 2, 1923

2 Sheets-Sheet 1

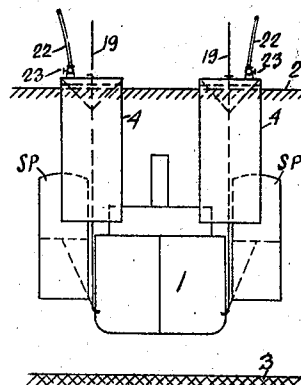
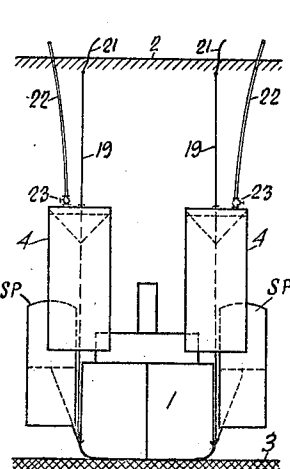
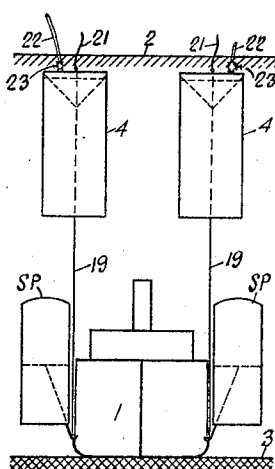
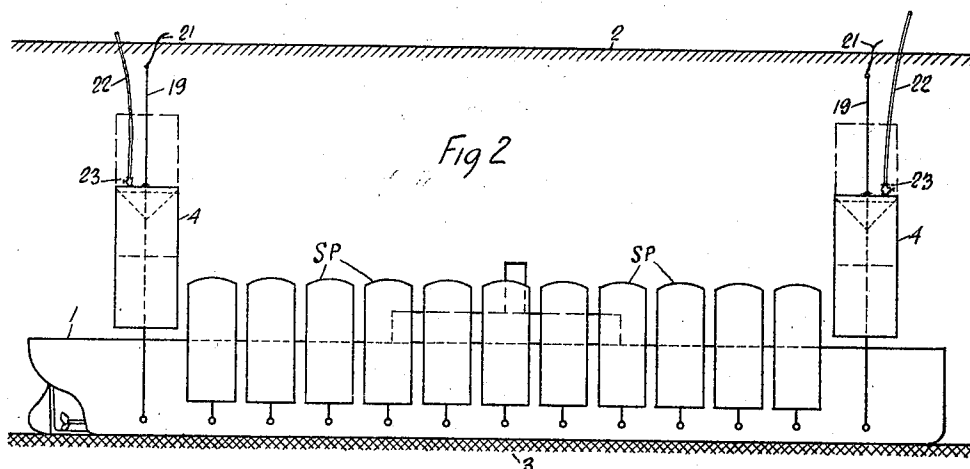
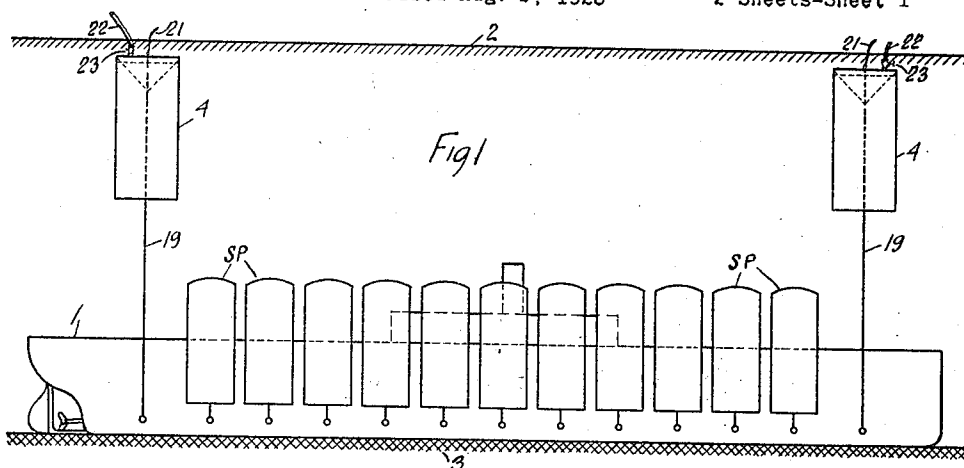


Fig 3

Fig 4

Fig 5

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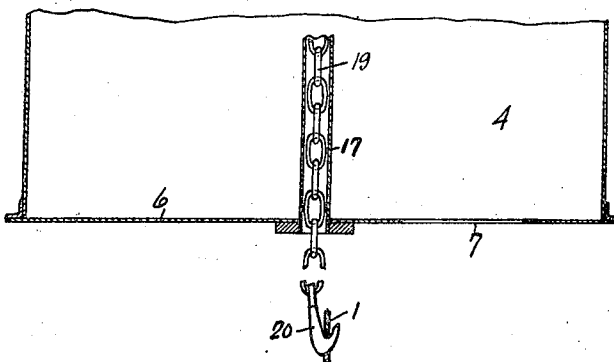
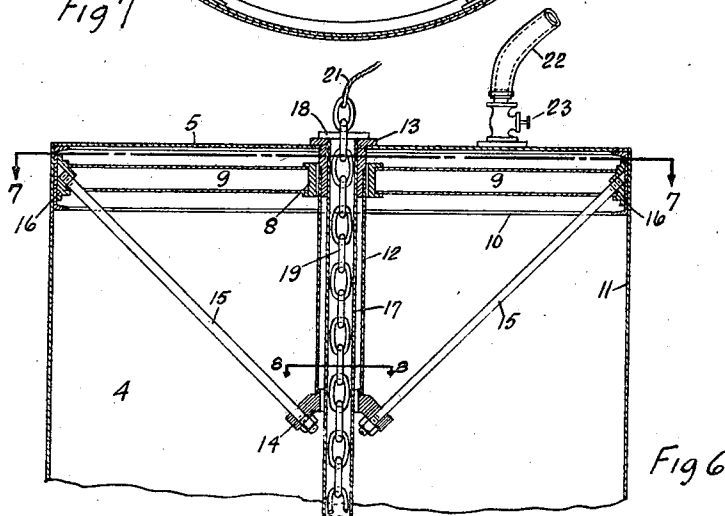
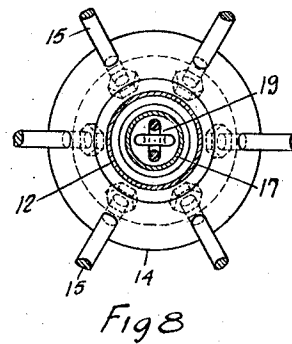
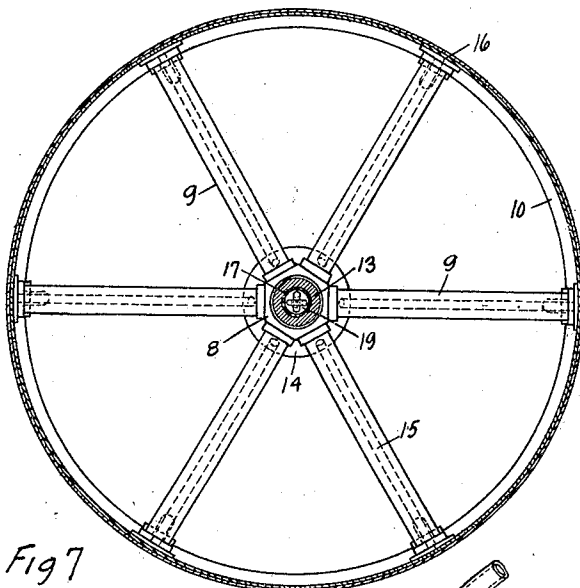
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

JESSE W. RENO, OF NEW YORK, N. Y.

RAISING SUNKEN SHIPS.

Application filed August 2, 1923. Serial No. 655,189.

To all whom it may concern:

Be it known that I, JESSE W. RENO, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented a new and useful Improvement in Raising Sunken Ships, of which the following is a specification.

This invention relates more particularly to a method of raising sunken ships submerged in comparatively deep water, which is carried out by the use of buoyant devices consisting of vertical pontoons filled with air, and which method has for its principal object briefly stated to raise sunken ships substantially on level keels or with only moderate inclination and without objectionable list which might seriously interfere with the successful operation of raising the ships. Another object of the invention is to provide an improved vertical pontoon of special construction and especially adapted for use in carrying out the method. Still other objects of the invention will appear in the specification and claims.

I attain these objects by the method hereinafter described and the pontoon illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of a large sunken merchant ship submerged on the bottom of the sea with my vertical pontoons attached thereto.

Figure 2 is a side elevation similar to Figure 1, except that the pontoons at the bow and stern are shown deeper in the water than in Figure 1.

Figure 3 and Figure 4 are end views of Figures 1 and 2 respectively.

Figure 5 is an end view similar to Figure 4, except that the ship is shown as having been raised off of the bottom by my method and pontoons but is still submerged.

Figure 6 shows a vertical section of the present pontoon with its middle broken away and a chain passed through it in its vertical axis.

Figure 7 shows a sectional plan view of the upper end of my present pontoon through the line 7—7 Figure 6.

Figure 8 shows a section plan view of my present pontoon through the line 8—8, Figure 7.

In order that the principle of my method invention may be clearly understood in advance of the description hereinafter of the method, I will explain that I have had prac-

tical experience in raising a submerged ship to the surface from comparatively deep water, which disclosed to me that sunken ships may be found to be resting on the bottom with one end higher than the other or in other words not on level keels and also with a list, and possibly on their side, and that these positions may have had the effect of shifting the cargoes, and where vertical pontoons are used for raising the ships such positions of the ship may have very destructive effects upon the vertical pontoons especially as the vertical pontoon has a tendency always to remain vertical in the water and any force which tends to prevent this may cause dangerous or excessive strains on the walls of the pontoons. Again, even if the ship is found lying on an even keel and without list it is probable that the weight of the submerged ship and cargo is unevenly distributed, in which case it is likely that in the operation of raising the ship by vertical pontoons it would come up one end foremost, and as it is impossible to find out by calculation whether or not the weight of the submerged ship and cargo is evenly distributed and therefore which end of the ship is the heavier or which side is the heavier, it may be that lifting pressure applied to the ship would change the stability of the position of the ship to the great disadvantage of the work of completing the raising of the ship to the surface. Furthermore, it is important to know the exact time when the ship will start to rise from the bottom so as to afford opportunity and time to remove the mother ship and other equipment on the surface out of the way, as they might be anchored over the sunken ship. From the aforesaid considerations it will be understood that it is of the greatest importance to have complete control over the positions and motions of the ship during the operation of raising it to the surface.

Referring now to the drawings, I will proceed to describe my method. Figures 1 to 4 inclusive indicate a large merchant ship, 1, submerged in comparatively deep water, 2, on the bed of the sea, 3. Figure 5 indicates the ship as having been raised from the bottom, but still submerged and the tops of the pairs of pontoons, 4, attached to the ship slightly above the surface. On account of the Figure 5 being an end view only one pair of pontoons can be seen. In preparing to apply my method of raising

the ship, I first examine her structural plan and cargo manifests, and from that I calculate the weight of the submerged ship and cargo. Let it be assumed for example that
 5 the total weight is ten thousand tons. I then proceed to attach to the sides of the ship, between the bow and stern, a sufficient number of vertical pontoons, SP, of an aggregate lifting power enough to lift, say
 10 ninety per cent of the total weight of the ship and cargo as submerged, or in the ship supposed, nine thousand tons. I might remark that it is always well to be on the safe side as to the estimated weight of the submerged ship and cargo, and, therefore,
 15 I will fill with air all of the submerged side pontoons so that their combined lifting power will be, say, at least ninety per cent of the buoyancy necessary to raise the ship with its cargo. I prefer to use for the side
 20 pontoons the standard vertical pontoon patented to me in my Patent No. 1,373,672, dated April 5, 1921. In this condition with pontoons attached, the ship and cargo will
 25 weigh one thousand tons, therefore, if additional pontoons having combined lifting power of one thousand tons be attached to the ship, it would rise to the surface; but as it is impossible to tell by calculation
 30 whether or not she will come up on substantially an even keel or if one end comes up foremost which end it will be, or, stated in other words, which end is the heavier, I proceed to weigh the submerged ship and
 35 cargo, so that I will know in advance of the application of the additional lifting power to the ship exactly how much additional buoyancy it will be necessary to add to the ship to raise it to the surface, and,
 40 also, whether or not other units of buoyancy are required in addition to those already attached to the ship, and if so, how many units and the proper locations for them. My method of weighing the submerged ship and cargo is as follows: first,
 45 I attach either to the bow or stern, as preferred, a pair of vertical pontoons, one pontoon of the pair on one side of the ship and the other pontoon of the pair on the opposite side of the ship. The end pontoons
 50 are preferably of larger size than those attached to the sides of the ship. In the beginning of the operation, the end pontoons are located only a few feet below the surface as indicated in full lines in Figure 1. In order to weigh the ship it is only necessary to force sufficient air into the pair of end pontoons to raise the end a few feet off
 55 of the bottom. By keeping the top of the pair of pontoons a short distance below the surface the end of the ship will be raised only that distance which will not have any appreciable effect upon the shifting of the cargo or upon pontoons SP attached to the
 60 sides of the ship. Let it be assumed that

the stern is lifted first; I make a note of the amount of pressure force that was necessary to apply in order to lift the stern, and I determine from the force applied the amount of displacement of the water in the pair of
 70 pontoons at the stern, and I then allow the air to escape therefrom and let the stern sink to the bottom. I then proceed to lift the bow of the ship a few feet by the pair of pontoons attached at that end, and note
 75 the amount of displacement of water, or lifting power applied as was done in respect to lifting the stern. I then allow the air to escape, and the bow to sink to the bottom. Knowing the total buoyancy exerted by the side pontoons and the lifting force
 80 necessary to lift the bow and stern, I can by using a simple, well-known mathematical formula applicable to the case calculate the correct weight of the ship with its cargo,
 85 as submerged, which enables me to know exactly how much additional lifting power is needed to raise the ship; which is what I desire to know in advance in order to carry out my method of applying only the necessary pressure and stabilizing the ship during the operation of raising it. The four
 90 stabilizing or weighing pontoons, two at the bow and two at the stern, are supposed to have when entirely filled with air a buoyancy more than sufficient to supply the deficiency of ten per cent. I might mention at this point in the description of weighing the ship that the practice of raising first one end of the ship and then the other end has an additional valuable feature in that it
 95 gradually breaks the suction seal between the ship and bottom. With the two pairs of pontoons attached to the ends of the ship, I proceed to lower them, say, to the position of the two pontoons indicated in the dotted outline of the pontoons in Figure 2, which position will be assumed to be approximately twenty feet below the surface; therefore, the conditions then will be perfectly safe, in raising the ship, to force air into the two pairs of end pontoons located at that depth, as when the ship rises with, may be, one end rising faster than the other end, the inclination of the ship will be only moderate because the two pairs of
 100 pontoons at the ends of the ship are simultaneously rising towards the surface and the pair in advance of the other pair will stop rising when the pair reaches the surface. To complete the operation of reclaiming the suspended ship, it can be towed to shallow water and grounded; and there if desirable the two pairs of end pontoons can be lowered again, say a distance of twenty feet
 105 more or less or whatever distance is desirable or permissible, and the operation of raising the ship be repeated. In some cases it may be found to be desirable to lower the two pairs of end pontoons to a greater dis-
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tance than that mentioned above, say for example, to the position shown in full lines in Figures 2 and 4, with their lower ends more or less near the deck of the ship.

5 With the pairs of end pontoons in the last mentioned position, the operation of raising the ship is similar to that last described; in fact, the positions of the end pontoons and the ship as raised but still submerged as indicated in Figure 5, may be assumed to be their positions after the pairs of end pontoons as shown in full lines near the ship in Figures 2 and 4 have been operated to raise the ship to the position shown in Figure 5. The distances and weights and amount of additional buoyancy or lifting force required above mentioned are assumed and used herein merely for the purpose of illustrating the application of my method of lifting first one end of the ship off of the bottom, and then allowing it to drop to the bottom, and then likewise the other end, and raising a ship. It is obvious of course that the weight of ships and cargoes vary.

25 I am aware that ships have been raised by having surface pontoons or other surface vessels attached to them by chains or wire ropes and allowing the tide to raise the ship after which it would be towed to shallow water, but this has only been accomplished in the case of small ships because it would be dangerous to have all the pontoon equipment required to raise a ship floating on the surface at one time, for in case of rough weather, such equipment would be dashed to pieces. With my invention, only a small fraction of the pontoon equipment would be at the surface and the pontoons are separated to such a distance apart that the action of the waves would have no effect upon them. It is well known that there is very little motion by a surface wave even during bad storms below a depth of sixty feet, therefore, my large aggregation of lower pontoons attached to the sides of the ship would not be affected.

I have mentioned above that my standard vertical pontoons patented to me can be used for the two pairs of end pontoons, but I prefer that the present pontoons shall be used for that purpose. They will have a lifting power of three hundred tons each when filled with air and their dimensions will be sixteen feet in diameter with a length of fifty-six feet and it is proposed to make them of steel. They are preferably of cylindrical form and closed at the upper end and partially closed at the lower end in order to permit them to be towed from the shore to the wreck in a horizontal position. The upper end of the pontoon has to take the entire strain of the lifting force which in this case amounts to three hundred tons; therefore I gave great care to the construction of that part of the pontoon. Re-

ferring to Figures 6, 7 and 8, the pontoon is shown as a circular hollow cylinder 4 with the upper end as viewed in Figure 7 closed by a head 5 and the lower end partially closed by a head 6, having a comparatively large hole 7 in it. Beneath the center of the closed head is a hollow hexagonal hub 8 having a circular hole through its center; the hub is supported by six struts 9, their inner ends secured to the hub and their outer ends riveted or welded to a circular channel piece 10, riveted or welded to the interior surface of the cylindrical shell 11 of the pontoon. Through the central hole of the hub 8 is passed a round hollow column 12 which is free, however, to contact with the hub. To the upper end of the column 12 is welded a short steel pipe 13, having a flange at its upper end riveted or welded to the closed head 5 of the pontoon. The lower end of the column 12 is welded to a steel ring 14, which has a hole through its center. To the ring are attached the inner ends of six tension rods, 15, and their outer ends fastened to cast steel fittings 16 secured to the circular channel piece 10. The ends of the tension rods 15 may be secured to the ring 14 by threads on their ends and nuts, and to the fittings 16 by threads on the ends of the rods screwed into the fittings, as shown in Figure 7. It will be perceived that by this construction I provide a strong truss for transmitting the weight of the ship through a central chain 19 to the periphery of the pontoon. Inasmuch as any serious distortion of the pontoon would be apt to cause leaks at the joints, my construction of pontoon provides means whereby no vertical strains are placed upon the hexagonal hub 8 into which the six struts 9 are seated, thereby leaving the struts under no other strain than that of compression, for which of course, they are best suited. It will be understood that a heavy strain, say three hundred tons applied to the six tension rods 15, namely fifty tons per rod would have a tendency to elongate the rods; therefore if the central column 12 were secured to the hexagonal hub, the six struts 9 would be pulled out of the horizontal plane and probably be broken loose from their connection with the circular channel piece 10 at the inner periphery of the pontoon. In order to counteract this tendency, I permit the central column 12 to slide freely in the hole in the center of the hexagonal hub 8. To the short pipe 13 at the upper end of the column 12 is welded a steel pipe 17. The closed head 5 or cover plate being of large size it has considerable flexibility, considered as a diaphragm, so that any motion of the central column 12 due to the elongation of the tension rods 15 will not be destructive to the head. In order

to facilitate the proper adjustment of the pontoon to the ship, I provide a vertical steel pipe 17 open at both ends and continuous between the heads of the pontoon. The ends of the pipe are welded to the top and bottom heads of the pontoon. A chain can be drawn through it, thus setting the pontoon at the right height. The chain is kept from being pulled down by the weight of the ship by a steel pin 18 engaging a link in it. The pontoon is attached to the ship in the case shown by means of a hook 20 which hooks into a hole in the side of the ship as indicated in Figures 1 to 5 inclusive. The chain can be drawn up through the vertical pipe 17 by means of a rope 21, the pontoon floating vertically on the surface with only enough air in its upper end to keep it from sinking, it being understood that the vertical pipe 17 welded to the top and bottom of the pontoon prevents the air from escaping between the joints of the pipe and pontoon heads. The pontoon being attached to the chain by the pin 18 and the lower end of the chain hooked to the ship as described, from a source of compressed air supply carried on the mother ship at the surface (not shown) air is forced through a pipe 22 secured to the closed head of the pontoon and forces the water down and out of the bottom hole 7 of the pontoon. If one end of the ship is raised and it is desired to allow it to sink to its previous position all that is necessary then is to open the valve 23 in the pipe 22 and allow the air to escape from the inside of the pontoon.

Having described my invention what I desire to secure by Letters Patent of the United States is:

1. The method of raising a submerged ship from off of the bottom of the sea, consisting first in applying lifting pressure to the ship as a whole but not quite enough to lift the ship off of the bottom, second, with the ship in that state of buoyancy, applying additional pressure to one end of the ship and lifting that end off of the bottom, and then allowing it to sink to the bottom, and then applying additional pressure to the other end of the ship and lifting it off of the bottom, and then allowing it to sink to the bottom, and, third, then applying additional pressure to the ship sufficient to raise the ship.

2. The method of raising a sunken ship off of the bottom, consisting first in applying a certain amount of lifting force to the ship but not enough to raise it off the bottom, second in applying at one end of the ship a lifting force sufficient to lift that end off of the bottom, thereby ascertaining the weight of that end, and then in allowing the end to sink to the bottom and applying a lifting force to the other end sufficient to

lift it off the bottom, and then allowing it to sink to the bottom, thereby ascertaining the weight of that end and the weight of the ship, and third applying additional lifting pressure to raise the ship.

3. The method of raising submerged sunken ships consisting first in applying to the ship between the bow and stern buoyant devices with not quite enough buoyancy to lift the ship off of the bottom, second applying at the bow and stern additional buoyant devices and causing one of said additional buoyant devices to lift one end of the ship off of the bottom and then allow the lifted end to sink to the bottom and then causing the additional buoyant device at the other end to lift that end off of the bottom and then permit said end to sink to the bottom and then causing the buoyant devices concurrently to raise the ship.

4. A circular vertical pontoon for stabilizing sunken ships in the operation of raising them, said pontoon having a closed head at its upper end and open at its lower end, a truss within the pontoon comprised of a vertical column secured to the middle of the closed head and its lower end free and within the pontoon, and tension rods their inner end fast to the free end of the column, and their other end fast to the inner periphery of the pontoon.

5. A circular vertical pontoon for stabilizing sunken ships in the operation of raising them, said pontoon having a closed head at its upper end, a truss within the pontoon comprising a hub with a hole through it, a series of horizontal struts their inner ends secured to the hub and their outer ends to the wall of the pontoon, a vertical column passed through the hub, and having its upper end secured to the closed head, a ring secured to the lower end of the column and tension rods their inner ends secured to said ring and their outer ends secured to the wall of the periphery at the outer ends of the struts.

6. A circular vertical pontoon for weighing and stabilizing a sunken ship in the operation of raising the ship, said pontoon having a circular channel piece secured to its periphery at its upper end, a closed head secured to its upper end, said head having a circular hole through its center, a short pipe in said hole and having a flange secured to the head, a hollow vertical column its upper end secured to the short pipe, a hub around the upper end of the column, struts having the inner ends secured to the hub, and their outer end secured to the channel piece, a ring secured to the lower end of the column, tension rods having their lower ends secured to the ring, fittings secured to the channel piece and to which the outer ends of the tension rods are secured.

7. A hollow vertical pontoon having a

closed head at its upper end, and provided with a truss comprising a vertical column having a free lower end within the pontoon, and its upper end secured to the center of the head, a hub around the upper end of the column, but free of it, struts their inner end fast to the hub and their outer end fast to the side of the pontoon; and tension rods their inner ends secured to the free lower end of the column and their outer ends secured to the periphery of the pontoon.

8. A hollow vertical pontoon having a

closed head at its upper end and a vertical column its upper end fast to the center of the head; radial horizontal struts, their outer ends secured to the periphery of the pontoon near the head, and a central hub freely encircling the column at its upper end near the head, the inner ends of the struts secured to the hub.

In testimony whereof, I have signed my name to this specification.

JESSE W. RENO.