

May 20, 1930.

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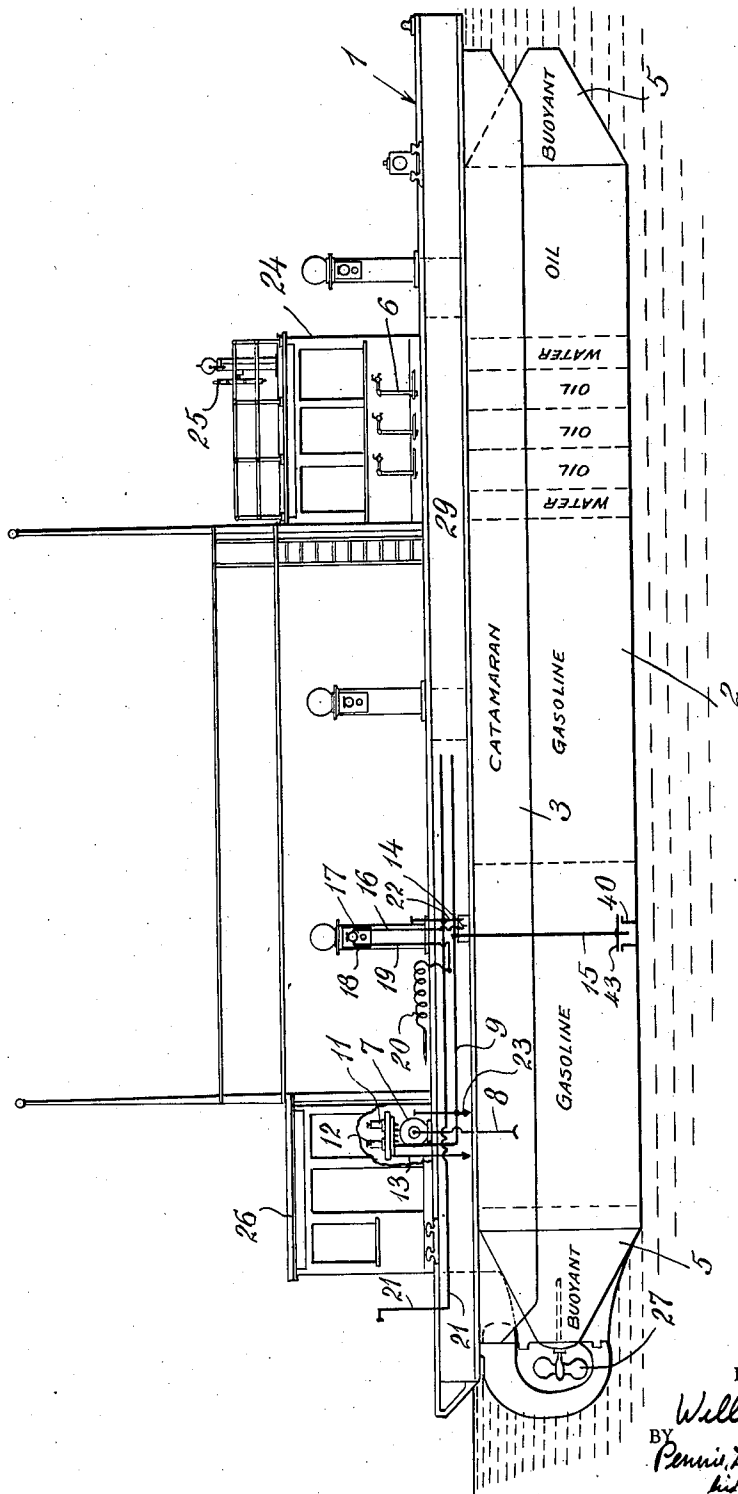
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OIL CARRYING MARINE VESSEL

Filed Jan. 21, 1928

3 Sheets-Sheet 1

Fig. 1,



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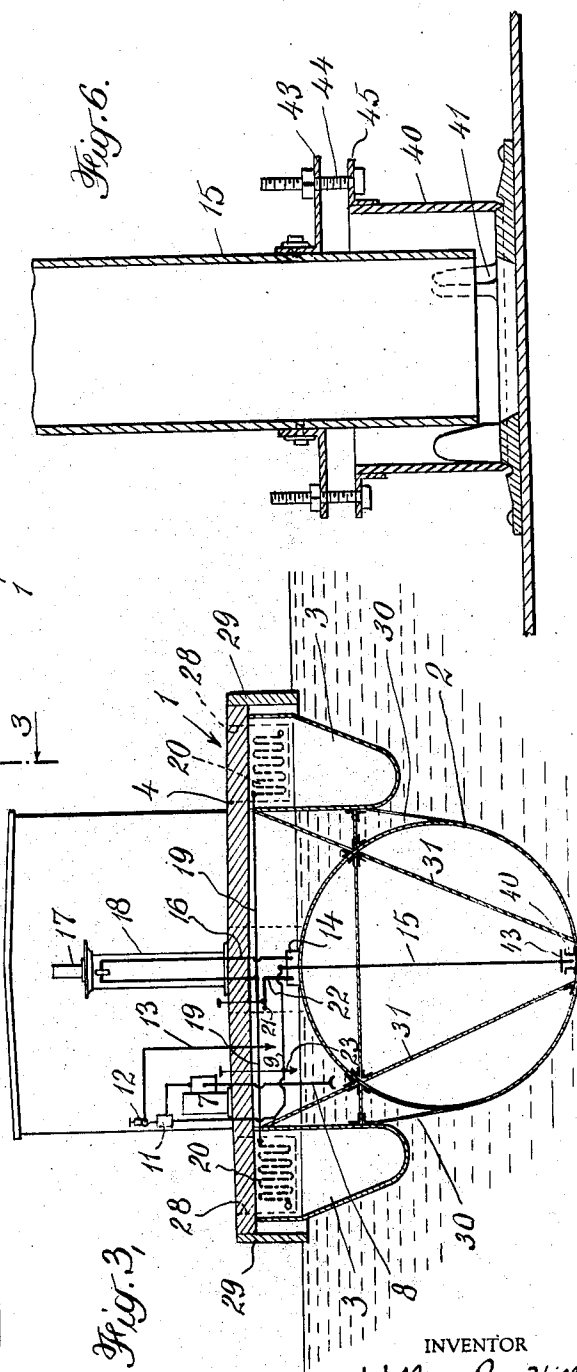
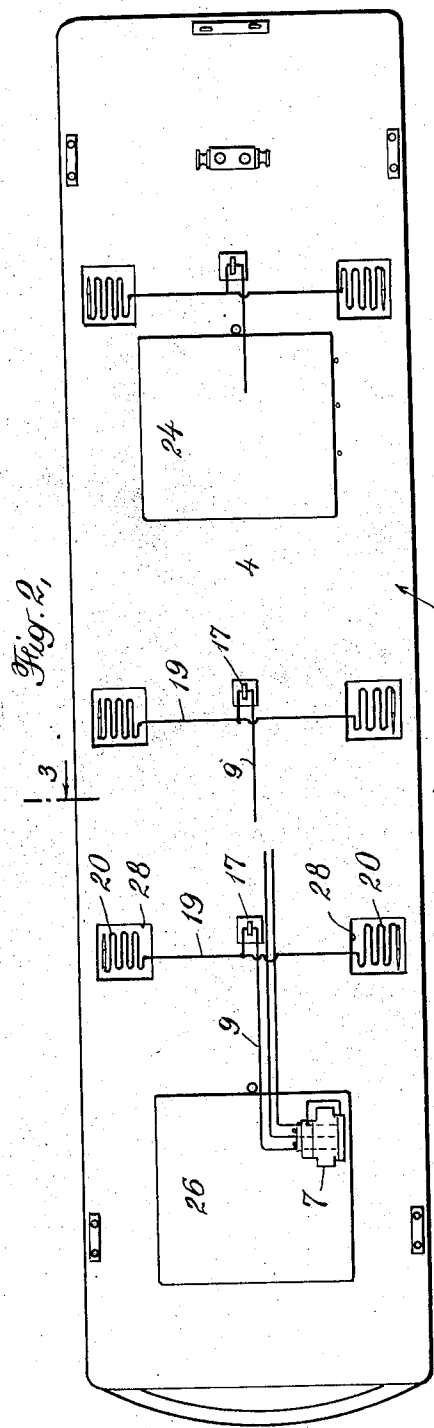
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OIL CARRYING MARINE VESSEL

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OIL CARRYING MARINE VESSEL

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Fig. 4,

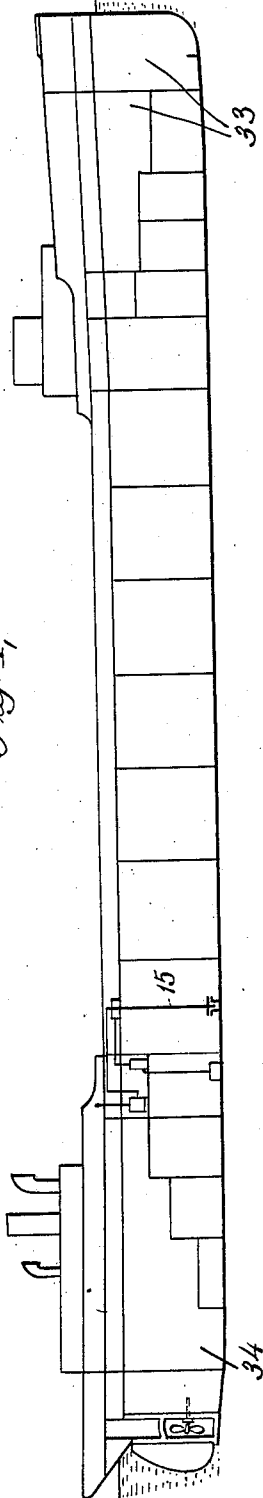
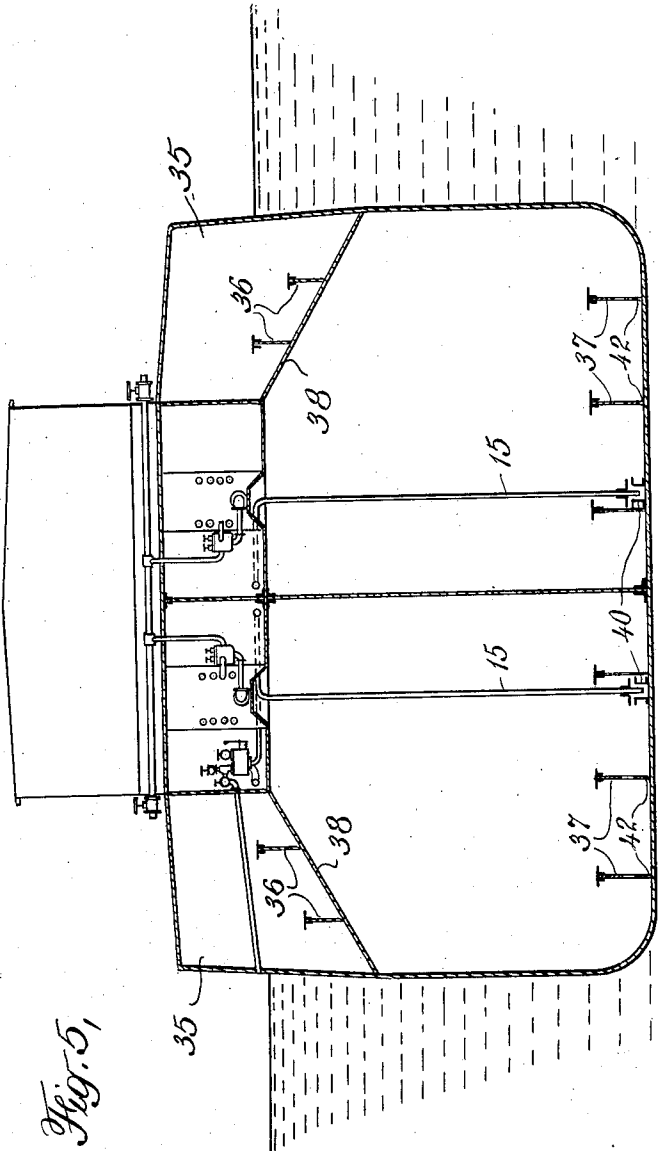


Fig. 5,



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OIL-CARRYING MARINE VESSEL

Application filed January 21, 1928. Serial No. 248,293.

This invention relates to oil-carrying marine vessels such as tank ships for transporting and floating supply stations for dispensing oils. Tank ships and floating supply stations as commonly constructed carry their oil as dead weight, which means that the vessel must have sufficient buoyancy and strength to carry itself and its load in all weathers. So far as it affects the major design of the vessel, that is as regards buoyancy and rigidity, the oil cargo might as well be coal or pig iron, wherefore it is easy to sink an oil-carrying vessel by overloading her with oil, despite the fact that oil is lighter than water. As a result vessels designed to carry heavy oil cargoes must be large and correspondingly strong.

In accordance with the present invention I take advantage of the fact that oil is lighter than water to carry it, not as a dead weight tending to sink the ship, but as a positive levitating force contributing to the buoyancy of the whole. In doing this I construct my vessel as a raft from which depends a tank or plurality of tanks for the oil, normally submerged. When filled with oil these tanks have a positive buoyancy and tend to float rather than sink the raft. To empty such tanks, however, by pumping out the oil and replacing it with air would be dangerously to increase their buoyancy. It would also create a free oil surface in each tank which would impair the stability of the vessel and result in the formation of explosive vapors. I therefore employ a hydraulic system for emptying and filling the tanks, for with such a system the tanks are always completely filled with liquid—oil or water or both. As the tanks may at times be completely filled with water, the raft must have sufficient buoyancy to float itself and the tank material under this limiting condition; therefore as oil is pumped into the tanks the effective load is lightened, and the vessel rides higher in the water. Thus arises the apparent anomaly of a decrease in draft with an increase in cargo carried.

It will be apparent from the careful consideration of the foregoing that my vessel is in effect a skirted raft, that its a buoyant

raft from which depend skirts enclosing a space sealed at the top by the raft itself, but at the bottom, open to the sea, the raft being so designed that the enclosed space can be and normally is always completely filled with liquid. With such an arrangement the sea water within this space cannot possibly act as a load on the raft, and any oil entrapped there must of necessity tend to raise the raft. Therefore when this skirt-enclosed space is provided with a bottom, this bottom, when the vessel is in quiet waters, in no sense supports the cargo, but merely enables discharge of the oil by the forcing of water into the enclosed space, which water would otherwise pass ineffectually into the sea. However, the vessel cannot remain forever in quiet waters and oil would be lost through the open bottom of the enclosed space. A bottom is therefore a practical necessity but its function differs from the function of the ordinary bottom of the ordinary oil-carrying vessel.

In constructing my vessel I therefore construct a raft having sufficient buoyancy and rigidity to carry itself, its engines and other impedimenta, and the tank shells and their supports without regard for the oil cargo. Of course provision must be made for some support for the oil or water in a rough sea, but in doing this it is necessary only to calculate the bending stresses imposed by a liquid head equal to the vertical distance between the tank tops and the trough of the wave. Such a vessel is much lighter than a vessel built to carry its oil as dead load cargo, and much less expensive. Its efficiency in terms of vessel weight per gallon of oil carried is considerably higher than that of any dead weight vessel and in addition it is practically non-sinkable. A hole in the bottom of the ordinary tanker and she is likely to go to the bottom; a hole in the bottom of my vessel has no effect upon her sea-worthiness. Further advantages of my vessel equipped with its hydraulic system are elimination of free oil surface with its inevitable supernatant atmosphere of explosive vapors, and greater stability due to elimination of free surface and the fact that the metacentric

height varies only slightly as the tanks are emptied of oil, and that always toward safety.

In the accompanying drawings I have illustrated my invention embodied in a floating supply station, or harbor service station, and in a tank ship. The application of the principles discussed briefly above will be more clearly understood from the following description of these vessels, and in this description I shall also point out various other features of my invention not referred to previously. In these drawings Figure 1 is a side elevation of a floating supply station constructed in accordance with my invention; Figure 2 is a plan view of this station looking down upon the deck of the vessel; Figure 3 is a transverse vertical section taken along line 3—3 of Figure 2; Figure 4 is a side elevation largely diagrammatic of a tank ship constructed in accordance with my invention; Figure 5 is a transverse vertical section on a much enlarged scale taken through the control room of the ship illustrated in Figure 4, and Figure 6 is a sectional detail of a roll trap or device for preventing the entrance of oil into the water leg of a tank, the operation of which will be explained in greater detail later.

I shall first describe the application of my invention to the floating supply station illustrated in Figures 1, 2 and 3 of the drawings. The vessel illustrated in these figures consists primarily of a catamaran 1 from which depends a horizontally extending cylindrical oil tank 2. The catamaran itself consists of two spaced buoyant members 3 extending for substantially the length of the vessel, lashed together in any approved manner and bridged by means of a deck 4. The tank 2, as illustrated most clearly in Figure 3, is suspended between the buoyant members 3 with its top substantially at the water line. The ends of the tank, as illustrated in Figure 1, are provided with buoyant members 5 conically shaped so as to facilitate ease of movement through the water. The entire vessel, including the catamaran and the tank with its buoyancy compartments, is so designed that it will float when the tank is filled with water. The tank being completely submerged, the water within it does not act as a load and the buoyancy of the vessel need be sufficient therefore only to carry the catamaran and its various parts and the metallic shell of the tank.

The tank 2 is primarily intended to carry fuel oils such as gasoline or heavier oil for Diesel engines and for this purpose is divided by transverse partitions or bulkheads into three main compartments for carrying these oils. It is also provided with a plurality of smaller compartments for carrying water and lubricating oils all as most clearly indicated by the labels on Figure 1. The fuel oils are handled hydraulically, whereas the lubricating oils and water may be handled by ordi-

nary pumps 6 by means of which they are raised to a point of discharge above the deck of the catamaran.

I shall now describe briefly the hydraulic system which I employ. Hydraulic systems take advantage of the fact that oil is lighter than and immiscible with water so that water flowing into the bottom of a tank containing oil tends to cause the oil to flow from a discharge outlet situated at the top provided the water is introduced under sufficient head. I provide water under this necessary head by means of a pump 7 mounted upon the deck of the catamaran. This pump draws water from the sea through the pipe 8 passes it into a water pipe 9, one such pipe leading to each of the tank compartments. The pressure of the water in this water pipe is determined by means of a pressure reducing valve 11 and a pressure relief valve 12, the latter permitting water to spill overboard and into the sea through an overflow pipe 13 when the pressure rises above a predetermined maximum. Each tank compartment is provided with a service head 14 through which the compartments are filled and emptied. Extending downward through this service head to a point closely adjacent the bottom of the tank is a water leg 15 communicating at its upper end with the water pipe 9. Also communicating with the service head is a riser 16 extending upward through a meter 17 and a meter casing 18 mounted on the deck, thence downward and outward through two oppositely extending branch pipes 19 to discharge hoses 20 provided with nozzle control valves. Oil is fed to the tank compartments through an oil inlet pipe 21 having valved branches 22 leading to each service head.

I shall now describe briefly the operation of the hydraulic system. When a tank compartment having been emptied of oil and thereby filled with water is to be refilled with oil, I proceed as follows: The pump 7 is stopped and the water line 9 open to the sea through pipe 13. Oil is then introduced from some convenient source of supply through oil line 21 and flows by gravity through the service head and into the tank, the head under which the oil is introduced being sufficient to cause the water in the tank to flow out through water leg 15 and pipe 9 and into the sea through a valve controlled waste pipe 23. When the oil and water level in the tank has reached a point closely adjacent the bottom of the tank and hence dangerously close to the open end of the water leg, a valve in the oil inlet is automatically closed by means responsive to the oil and water level, preferably a float situated near the bottom of the tank, the float being designed to float on water and sink in oil. No more oil can enter, and the tank is full and as oil cannot be passed to waste harbor pollution is impossible. In discharging oil the

pump 7 operates to force water from the sea through pipe 9 and down water leg 15 displacing the oil in the tank and forcing it out through riser 16 through the meter and through discharge hose 19. When the water level has reached a point closely adjacent the top of the tank, and hence dangerously close to the oil discharge outlet, a valve situated at that outlet is automatically closed also by means responsive to the oil and water level, preferably another float, so that water cannot follow the oil through the riser and to the hose.

The deck of the catamaran is equipped with a forward cabin 24 which houses the various facilities for the crew and carries the ordinary steering-wheel 25 on its deck. It is equipped with an after cabin 26 which houses the water pump 7 and also the engine (not illustrated) for driving the vessel by means of the propeller 27. Each hose 20 is stowed away when not in use within a hose box 28 depressed below the deck level and provided when not in use with a cover which lies flush with the deck. The catamaran is also provided with longitudinally extending wooden fenders 29 which protect the buoyant members 3 along the water line.

It will be clear from the foregoing that the tank is always completely filled with liquid either oil, or water or both and oil being lighter than water when the tank is filled with oil the whole vessel rides slightly higher than when the tanks are emptied of oil and filled with water, although even under this latter condition the buoyancy of the vessel, as a whole, is ample, the water in the tank being, in effect, supported by the sea and not by the catamaran. The tank is amply protected by the longitudinal buoyant members 3 of the catamaran and by the fenders 29. It is also protected at its ends by the overhang of the deck, as illustrated most clearly in Figure 1. The tank is suspended from the catamaran by a series of metallic straps 30 and is amply reinforced internally by means of spaced plates 31.

In Figures 4 and 5 I have illustrated the same principles applied to a tank ship. The bow and stern of this vessel, as illustrated, most clearly in Figure 4 are each provided with buoyancy compartments 33 and 34 respectively. Other buoyancy compartments 35 connect these forward and after compartments and extend vertically from the deck to a point somewhat below the water line. The ship is so designed that these compartments give her sufficient buoyancy to float even when her tanks are filled with water. These tanks are situated amidships between the forward and after buoyancy compartments 33 and 34 and beneath the compartments 35. Other and smaller tanks are situated at the bow and stern, but decrease in size toward the ends of the ship, as illustrated in Figure

4. The necessary rigidity is obtained by means of longitudinally extending structural members 36 situated above the tanks and other structural members 37 situated within and at the bottom of the tanks.

The tanks are provided with curved tops 38 having smooth inner faces so that it is not possible for oil to collect in pockets along the tops of the tanks. The structural members 37 which extend along the bottom of the vessel are within the tanks and although these do form pockets and would interfere materially with the operation of the ordinary tanker which carries its oil as dead weight have no detrimental effect in my ship because here the oil is not removed from the bottom of the tank, but from the top and it is only water which lies at the bottom of the tanks when the oil has been discharged.

These tanks are hydraulically operated by mechanism operating substantially the same as that described in connection with the oil supply station illustrated in the other figures and will not be again described here. I shall, however, describe the roll trap which I have invented for use, particularly in connection with hydraulically operated oil ships which may be subjected to heavy seas.

Where the tanks of hydraulic oil storing and dispensing systems are located on land, the angle of the line dividing the oil and water does not vary, for the simple reason that the tanks are fixed. On a ship, however, this is not true and as she rolls and pitches this angle may vary frequently and violently. Thus, when the tanks are filled or even substantially filled with oil, the ship may roll to such an angle that oil will enter the lower end of the water leg and immediately rise to its top displacing the water. Now, it is very important that the water leg should always be filled with water. I therefore provide the bottom of the tank with an upstanding collar 40 of slightly larger diameter than the water leg and into which the end of the water leg extends, as illustrated most clearly in Figure 6. The water leg is centered in the collar and steadied therein by means of three inwardly projecting radial lugs 41. The dimensions of this collar with relation to the water leg are such that it is always substantially filled with water so that even in the most extreme roll of the vessel no oil can approach the lower end of the water leg, and hence enter it.

From time to time it becomes necessary to clean oil tanks even when those tanks are hydraulically operated, and to do this the tanks are first cleared of oil by means of water and then the water drawn out through the water leg, the sediment passing with it. In order to enable this sediment at the bottom of the tanks, illustrated in Figures 4 and 5, to escape by means of the water leg, I provide the structural members 37 with spaced

openings 42 which enable the sludge and water to pass transversely to the lower end of the water leg and be sucked up. In order to prevent the collar 40 from interfering with this water clearing operation, I provide the lower end of the water leg with a flange 43 from which depend a plurality of threaded bolts 44, the heads of which engage an annular flange 45 on the collar 40. During water clearing the nuts on these bolts are turned to draw the collar 40 upward and thus give the water free and direct access to the lower end of the water leg.

Oil-carrying vessels constructed and operated in accordance with my invention have numerous advantages over such vessels designed to carry their oil cargo as dead weight. First of all the efficiency of my vessels in terms of weight of vessel per ton of oil carried is much greater. For example, a floating supply station designed to carry 140 tons of oil as dead weight would weigh, exclusive of the oil, about 200 tons. A floating supply station embodying the present invention would weigh about 60 tons. The saving effected in material and money is large. My vessels are practically unsinkable, the staving in of the bottom not only losing no oil but in no way affecting the buoyancy of the vessel. This is decidedly not true of dead weight vessels. Floating supply stations commonly carry their oils in tanks carried above the deck and these tanks constitute a constant fire hazard not only for the supply station itself but for the ships which it fuels. My station with its submerged tanks is perfectly safe. In addition to these, there are the advantages inhering in the use of hydraulic systems on shipboard—substantially constant buoyancy, unimpaired stability and freedom from explosive vapors overlying the oil due to the absence of free surface, utilization of clean oil withdrawn from the top of the tank, ease of tank cleaning, freedom from harbor pollution and flexibility of control.

I claim:

1. An oil-carrying marine vessel comprising the combination of buoyant members, a tank normally submerged and completely filled with oil or water or both carried by the buoyant members, and means for flowing oil out at the top of the tank by means of water forced in at the bottom.

2. An oil-carrying marine vessel comprising the combination of buoyant members, a tank normally submerged and filled with oil or water or both carried by the buoyant members and having a convex top, a discharge outlet for oil situated at the highest point in the tank top and means for flowing oil out through the discharge outlet by means of water forced in at the bottom of the tank.

3. A floating oil supply station comprising the combination of a catamaran having two

spaced longitudinal buoyant members, a tank depending from and intermediate the buoyant members, the tank being normally completely filled with oil or water or both and lying when filled with its top substantially at the water line, a deck spanning the space between the longitudinal buoyant members, and means carried by the deck for discharging oil from the top of the tank by means of water forced in at the bottom.

4. A floating oil supply station comprising the combination of a raft, a tank depending therefrom, normally filled with oil or water or both and lying when filled with its top substantially at the water line, an oil discharge pipe communicating with the top of the tank, a water pipe communicating with the bottom of the tank, an oil hose connected with the oil pipe, and a pump for forcing water into the tank through the water pipe to flow oil out through the oil line and hose.

5. In a floating oil supply station such as claimed in claim 4, the combination of a hose box situated at the side of the raft and below the deck level.

6. A floating oil supply station comprising the combination of a raft, a tank depending therefrom and lying when filled with its top substantially at the water line, separate compartments in the tank for fuel oils, lubricating oils, and water, hydraulic means for discharging the fuel oils and pumps for discharging the lubricating oils and water.

7. An oil-carrying marine vessel comprising the combination of buoyant members, a tank normally submerged and filled with oil or water or both carried by the buoyant members and having a convex top with a smooth inner face, the bottom of the tank constituting the bottom of the vessel, structural members lying within the bottom of the tank, a discharge outlet for oil situated at the highest point in the tank top, and means for flowing oil out through the discharge outlet by means of water forced in at the bottom of the tank.

8. An oil-carrying marine vessel comprising the combination of buoyant members, a tank normally submerged and completely filled with oil or water or both carried by the buoyant members, a water leg extending from the top of the tank to a point adjacent the bottom, a discharge outlet for oil at the top of the tank, means for forcing water into the tank through the water leg to flow oil out through the discharge outlet at the top, and a collar on the bottom of the tank into which the water leg extends whereby the lower end of the water leg is always submerged in water even when the vessel rolls or pitches.

9. A tank ship for transporting oils having buoyancy compartments at its bow and stern and extending along its sides and top near the water line, and oil tanks intermedi-

ate and below said compartments, normally submerged and completely filled with oil or water or both, means for forcing oil out at the tops of the tanks by means of water introduced at the bottom, the buoyancy compartments being capable of floating the ship even when the tanks are filled with water.

10 10. In an oil-carrying marine vessel having hydraulic means for moving the oil, the combination of a tank, a water leg extending from the top to a point adjacent the bottom thereof, and an upstanding collar on the bottom of the tank into which the water leg extends, the dimensions of the collar being such
15 that the end of the water leg always dips into water despite rolling and pitching of the ship and entrance of oil thereby prevented.

20 11. In an oil-carrying marine vessel having hydraulic means for moving the oil, the combination of a tank, a water leg extending from the top to a point adjacent the bottom thereof, an upstanding collar on the bottom of the tank into which the water leg extends, and means for lifting the collar from the
25 bottom of the tank during tank cleaning.

30 12. An oil carrying marine vessel comprising the combination of buoyant members, a receptacle for oil depending from the buoyant members and normally submerged, the buoyant members being capable of floating
35 themselves and the receptacle when the latter is filled with water whereby any oil in the receptacle tends to increase the buoyancy of the vessel.

40 13. An oil-carrying marine vessel comprising the combination of buoyant members, a tank normally submerged and filled with oil or water or both carried by the buoyant members, a discharge outlet for oil situated in the tank top and means for flowing oil out
45 through the discharge outlet by means of water forced in at the bottom of the tank.

In testimony whereof I affix my signature.

WM. REED-HILL.