Feb. 4, 1964 C. J. FOSTER 3,120,106

OFF SHORE MOORINGS

Filed Jan. 22, 1959 4 Sheets-Sheet 1

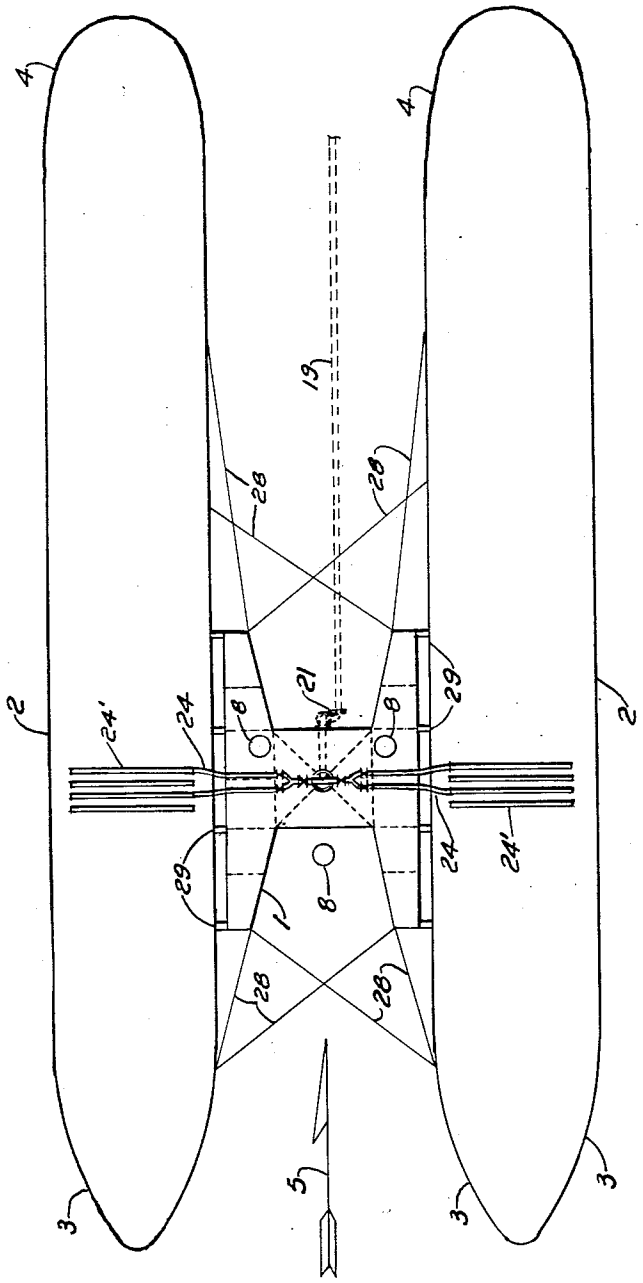

FIG. 1

WITNESSES

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Feb. 4, 1964 C. J. FOSTER 3,120,106

OFF SHORE MOORINGS

Filed Jan. 22, 1959 4 Sheets-Sheet 2

FIG. 2

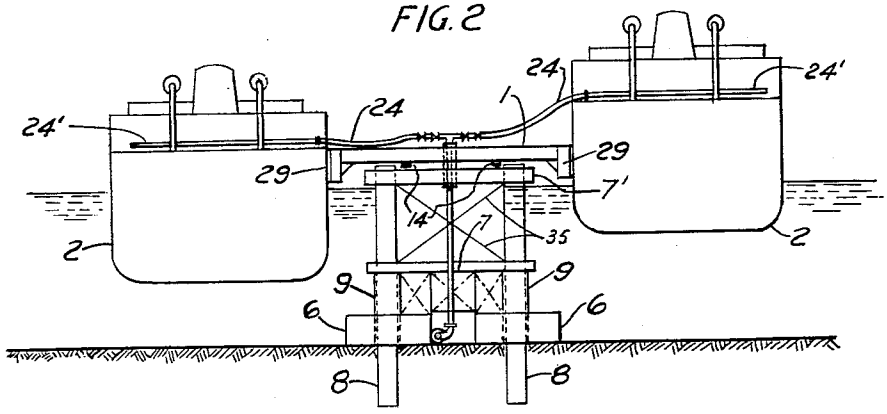
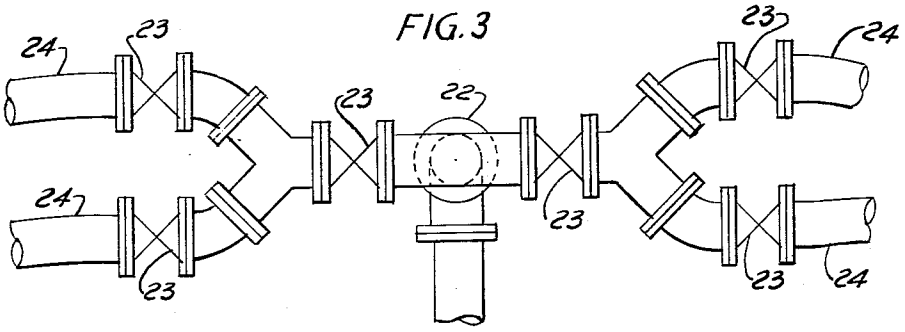


FIG. 3



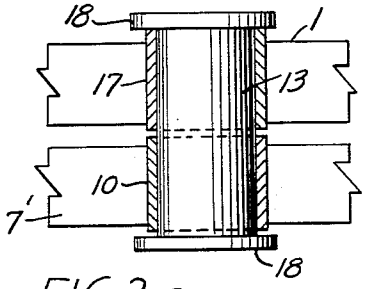


FIG. 2-a

FIG. 4

WITNESSES

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Feb. 4, 1964 C. J. FOSTER 3,120,106

OFF SHORE MOORINGS

Filed Jan. 22, 1959 4 Sheets-Sheet 3

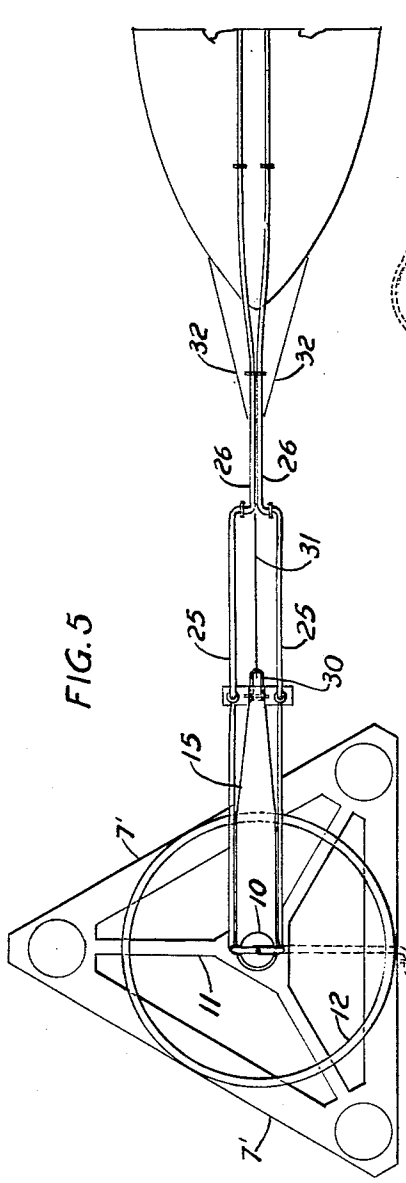

FIG. 5

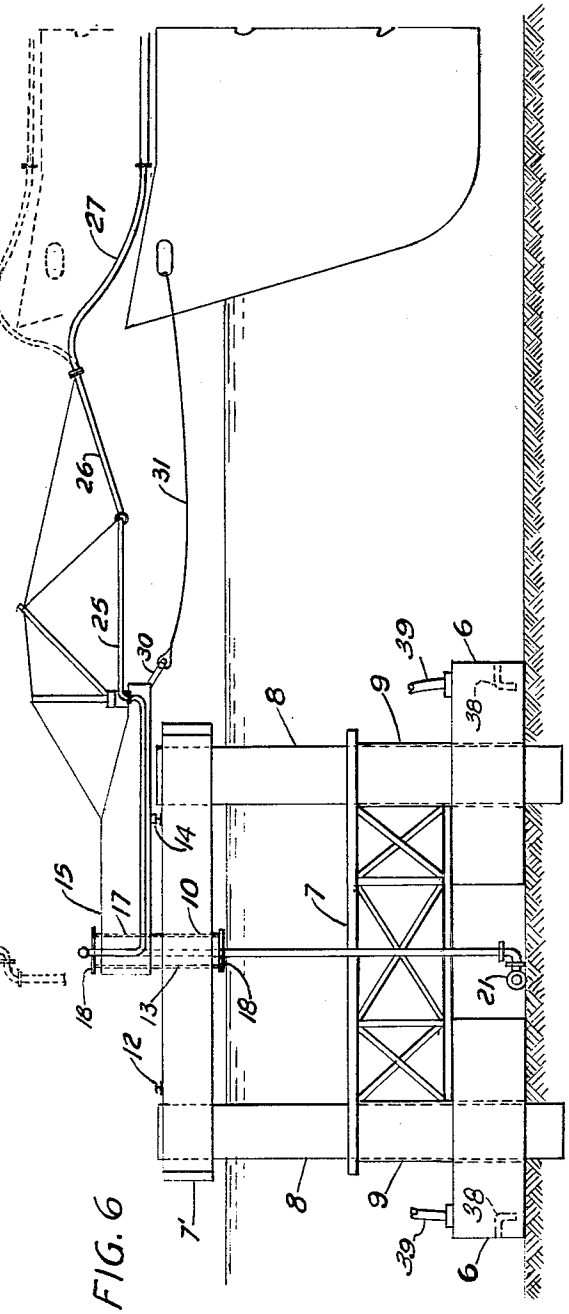

FIG. 6

WITNESSES

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Feb. 4, 1964 C. J. FOSTER 3,120,106

OFF SHORE MOORINGS

Filed Jan. 22, 1959 4 Sheets-Sheet 4

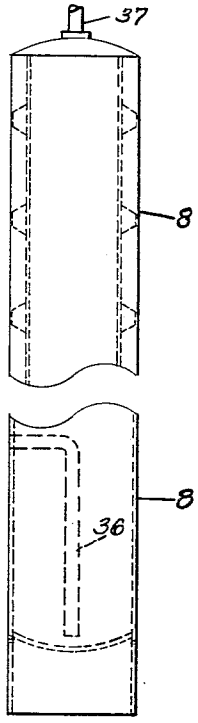

FIG. 7

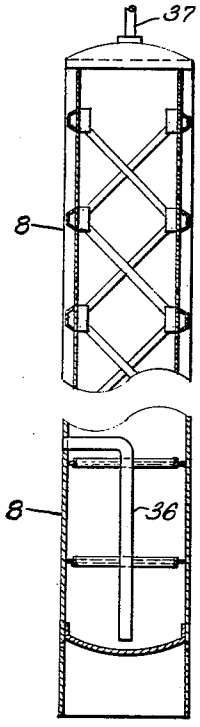

FIG. 8

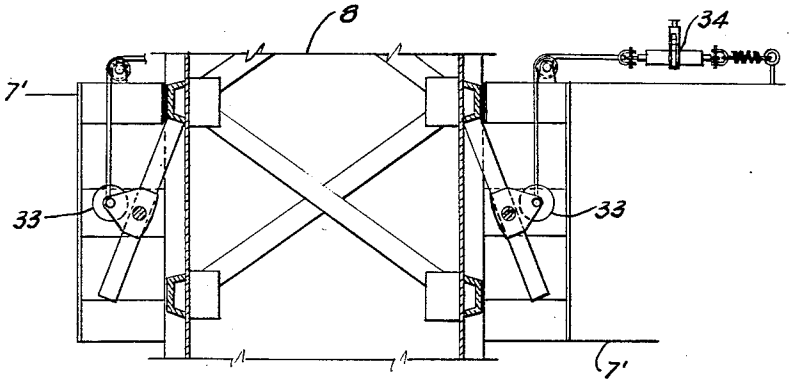

FIG. 9

WITNESSES

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3,120,106
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3,120,106

OFF SHORE MOORINGS

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Filed Jan. 22, 1959, Ser. No. 788,436
2 Claims. (Cl. 61—46.5)

My invention refers to mobile off shore moorings for maritime vessels and it is especially adaptable for the loading and unloading of the modern gigantic tankers requiring relatively deep waters to berth in. My preferred device is constructed similarly to my movable platform for off shore oil drilling, described in my copending application for Letters Patent, Ser. No. 680,119.

In order to provide a mooring platform to withstand a mooring pull of some 500 tons at a water depth of 100 feet, I have found it necessary to support the platform on three buoyant cylinders that are pressed into the firm ocean bottom through the soft bottom surface layers, and are braced laterally inside a tripod tank construction, that rests firmly upon the bottom of the sea. It is to be noted that in my tripod structure the direct load is equally divided on the three buoyant tanks, when the structure is afloat, and on the three vertical pylons when the structure is anchored to the sea bottom.

My invention is especially adaptable for the loading and unloading of two tankers at the same time. It has been ascertained that the mooring pull of a large tanker with its bow directed against the wind is in the order of 500 tons, or 1000 tons for two tankers.

One of the objects is therefore to provide an H-shaped swivel mooring to which two vessels at a time may be moored off-center in weather-vane fashion, so that the wind and waves will hit the vessels bow-end first.

It should also be noted that the mooring sweep of the two vessels has a radius roughly half that of the singly moored vessel. Besides the H-shaped mooring connection provides easy access to the vessel for making mooring line connections and also making pipe connections from an oil supply terminal at the center of the swivel mooring connection.

This invention has also for its object to provide a piped universal connection to the vessel from a shore pipe line, laid on the sea bottom. My preferred universal ship connection comprises in combination a swivel pipe joint at the top of a pipe riser round which the mooring is free to swing in the horizontal plane, and an end connection to the ship free to move up and down with the ship in a vertical plane.

In the drawing, FIGURE 1 is a plan view of my preferred twin mooring which shows two tankers properly moored and swung with the wind that is blowing in the direction indicated by the arrow. In this figure, the outlines of the three pylons are indicated in order to show that the pylons clear the bracing of the swivel mooring during the assembly prior to cutting them off to allow the twin mooring to swivel freely. FIGURE 2 is an elevation of the twin mooring showing two tankers moored thereto and shows the pylons cut off to clear the twin mooring. FIGURE 3 is a plan view of my preferred manifold that is pivotally connected to the top of a vertical pipe riser. FIGURE 4 is a side view of a vertical pipe riser being hoisted in its upright position. FIGURE 2–*a* is a fractional section of the interfitting of the pivot pipes of my preferred mooring swivel. FIGURE 5 is a

plan view of my preferred single mooring with its universal pipe connection from shore line to ship. This mooring is especially adaptable for waters exposed to the wind and the waves. FIGURE 6 is an elevation of the single mooring, and its universal ship to shore connection. It is to be noted that the substructure shown in FIGURES 5 and 6 is identical with the substructure of the twin mooring shown in FIGURE 2. It is also to be noted that FIGURE 6 shows the open cylinder 10 placed below the open cylinder 17 with a central fitted pipe 13 leaving the two open cylinders aligned and the upper cylinder free to swivel on top of the lower cylinder around the center pipe 13. FIGURE 7 is a side elevation of my preferred pylon or buoyant metallic cylinder, and FIGURE 8 is a cross-section thereof, and finally FIGURE 9 is a fractional section, showing my preferred pawl and step arrangement for the pylons.

In the drawing where like reference characters denote corresponding parts, 1 is my preferred twin mooring to which two tankers 2 may be moored at the same time. The tankers are shown, properly moored with their bows 3 projecting beyond the mooring substantially less than their sterns 4. The arrow 5 indicates the wind direction which, of course, is the direction in which the ships swing.

The anchor structure is a tripod, composed of three buoyant pontoons 6 that are kept together by the rigid triangular truss 7, and the pontoons are shown secured to the bottom by the pylons 8 which are threaded through the tanks and project into the sea bottom. The pylons pass through the open ended cylinders 9 that form the core of the buoyant pontoons and extend upwards beyond the pontoons the full height of the tripod truss 7, all as shown in FIGURES 2 and 6.

An open cylinder core 10 is secured to the center of the triangular platform 7′ by means of the spider framing 11, and this platform supports the circular roller track 12, which in turn supports the twin mooring 1. This mooring frame is provided with rollers 14, adapted to roll on the circular track. Proper individual roller bearings are secured at the under side of the mooring.

Referring to FIGURES 5 and 6, which show my preferred single swivel mooring 15 you note that in this mooring the swivel mooring is replaced by a swivel arm that is provided with only two rollers 14, secured thereto. The center support for both the twin and the single moorings is identical and comprises an open cylinder 17 placed on top of the open cylinder 10, and through the two open cylinders the central pivot pipe 13 passes. The pivot pipe is provided with retaining rings 18 which are welded to the ends thereof and these rings prevent an undue overbalance of the swivel moorings of the single as well as of the twin swivel mooring. In deep waters I prefer to insert a wire cross brace 35 between truss 7 and platform base 7′ as shown in FIG. 2. For very deep waters I prefer to repeat said bracing between intermittent rings that slide on the pylons until the wires are stretched tight between truss 7 and base 7′, accordion fashion.

The shore pipe 19 that connects with the oil loading platform is placed on the sea bottom in an approved manner and its end swivel pipe 20 is preferably made long enough to be close to or protrude above the water surface when it is lifted up as it swivels on the elbow swivel connection 21 just outside the truss 7, from where it proceeds horizontally to the swivel center where it is directed straight upwards as it passes through and beyond

the swivel pipe 13. A swivel connection manifold 22 turns with the swivel mooring and is provided with cut off valves 23 from which the flexible hoses 24 lead to the oil pipes 24' of the ships 2. I prefer to provide the single mooring connections with intermediate swivel pipes 25 and 26 which pipes swing in the horizontal and the vertical planes respectively. I also prefer to lash the flexible end hoses 27 together for part of their length not shown on the drawing leaving them free to move in a vertical plane for all their length while a substantial hose length is fully flexible to allow for easy made ship connections.

Proper mooring lines 28 are provided for the twin mooring to hold the ship firmly against the upright fenders 29 which extend from the sea level to the upper side of the mooring. The single mooring is provided with the mooring shackle 30 to which the wire rope 31 is attached to the bridle 32 which leads to the ship.

The operation of my device is as follows: First the structure is towed to location with the pylons raised high, although I prefer to substantially lower the pylons below the tank bottoms when the rig sails over deep water.

When the platform is to be anchored, the pylons are let down gradually by letting water enter into the pylons through valves not shown on the drawing. The pylons then press through the soft bottom layers by their own weight until refusal sets up, whereupon water is pumped into the pylons which are pressed deeper into the bottom. Now the double pawl and ratchet arrangement shown in FIGURE 9 is set to work.

As seen, I use two diametrically opposite built-in stepped tracks for the pylons, which tracks engage the double-ended pawls that are attached to the base platform which supports the circular track for the swivel mooring. The hand set pawls are actuated by the counterweights 33, when pressing the pylons down, and by a tension spring arrangement 34, when raising the pylons.

The tension spring arrangement is of the hand controlled ratchet type that causes the springs to slack in order to let the counterweights act, or oppositely to tighten them up in order to overcome the counterweight action and create a surplus spring tension which actuates the pawls in the manner illustrated in FIGURE 9.

The double ended pawl is preferably made out of a rectangular steel bar having two side plates welded bell-crank fashion to the middle thereof. The plates and the steel bar are bored to fit a pivot, which is attached to the structure, and the side plates are drilled to support a pin on which two counter weights are threaded with the end of the operating wire rope between them. The other end of the operating rope is attached to a standard steam boat ratchet pulling jack, that is in turn attached to a tension spring, which is anchored to the structure.

Now, therefore, when the jack is contracted as shown in the drawing FIG. 9, the spring tension overcomes the counter weights and the upper end of the pawl presses against the step track and engages the lower side of the steps forcing the pylon upwards by the buoyancy of the tanks 6, which is the condition when you want to pull up the pylons and move the structure to a new location.

On the other hand, when the jack is let out sufficiently to relieve the spring tension, the counter weights will take over and swing the lower end of the pawl against the step track and engage the top side of the steps thus pressing the pylons down in the sea bottom by the total weight of the structure and the flooded tank tripod that is during the placing operation temporarily attached to the base 7'.

Prior to the placing operation, the pontoons 6, evacuated of water, float on the surface with the pylons raised and empty. The structure is thus towed to the mooring site.

In the placing operation the pylons are flooded, causing them to sink. With the counter weights pressing the lower ends of the pawls against the step track and the pontoons flooded and with their buoyancy substantially destroyed the weight of the structure will force the pylons step by step into the sea bottom until bottom resistance is obtained, whereupon the tripod is detached from the platform 7' and sunk to the bottom by the flooding of the tanks. The action of the apparatus with ships properly moored thereto is obvious. The wind will swing the ships together with the mooring windwards and the flexible end hoses will accommodate the up and down movement of the vessel when it is loaded and unloaded. You will note that the mooring for the single ship is provided with a hinged pipe arrangement that permits the lowering of the twin end hoses to the ship deck where they may be conveniently secured to the oil lines of the ship.

My preferred submarine anchor structure is shown in the drawings as a tripod, composed of three buoyant pontoons 6, that are spread widely apart and kept rigidly together by a triangular deep truss 7, in order to render the anchor structure bottom stable, but a square spread-apart submarine structure composed of four pontoons will resist a substantially greater mooring pull than the shown triangular one. Although my oil pumping device in my copending application and my present device are similar, the lateral load requirements are much more severe in the mooring device than in the oil pumping device, as the former must sustain a lateral moment in the order of 100,000 foot tons in addition to the wind and wave moments.

Therefore it is clear that ship mooring devices do not belong in the same art as do the stilt supported modern oil pumping devices, which if such great lateral mooring pull were applied thereto would invariably turn over and collapse.

Finally it is to be noted that the double pronged pawl of my present invention allows for the step by step withdrawal of the pylons from the sea bottom by reversing the method employed at the installation of the device, a feature lacking in my copending application for an oil pumping platform.

Having described my invention, I want it understood, that besides the apparatus shown, I also claim as my invention all alterations and modifications that properly fall within the scope of my invention.

I claim:

1. In an offshore mooring structure for deep water having beneath it at least three hollow buoyant tanks, a framework attached to the tanks holding them rigidly together to form a unit, a platform above the framework, a vertical buoyant pylon slidably passing through each of the tanks and the platform and braced at all times laterally by the framework, said pylons having two depressed stepped tracks one diagrammatically opposite to the other on the sides of the pylons, two double ended pawls attached to the platform engaging said tracks, means to move the upper ends of the pawls into engagement with the step tracks while moving the lower ends out of engagement therewith when pushing up the pylons, and means to move the lower ends into engagement with the step-tracks while moving the upper ends out of engagement therewith when depressing the pylons and means to flood the buoyant tanks and the buoyant pylons when depressing the pylons.

2. In an offshore mooring structure after claim 1, means for holding the platform and framework temporarily together, a circular roller track on the platform, a swivel mooring supported on rollers on said track, a pipe riser from a submerged pipe line swung up to protrude above the water, a swivel manifold attached to the platform and piped to the pipe riser and flexible means connecting the manifold to follow the ship up and down as the unloading and loading thereof may decree.

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