United States Patent

Sander et al.

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[45] **June 13, 1972**

[54] OFFSHORE TERMINAL

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[21] Appl. No.: **55,200**

[30] **Foreign Application Priority Data**

July 23, 1969 Germany ..... P 19 38 018.8

[52] **U.S. Cl.** **61/46,** 137/236, 114/230, 9/8

[51] **Int. Cl.** **E02b 17/02**

[58] **Field of Search** ..... 114/230, .5 F, .5 BD; 9/8 P; 61/46, 48, 54; 137/236

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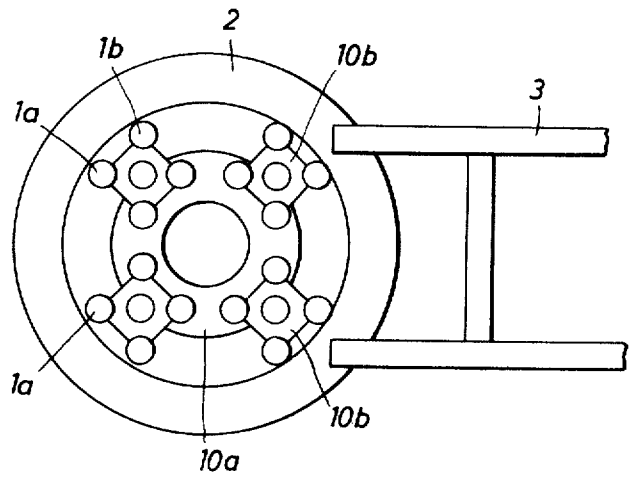
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[57] **ABSTRACT**

An offshore terminal is constructed from tubing to establish a resiliently yielding tower. A floating platform as docking and cargo handling berth is linked to the tower by means of a floating collar through which impact forces acting on the platform are reacted into the tower. Different embodiments include single pipe and plural pipe tower constructions as well as outrigger-like platforms and platforms traversed by the tower.

1 Claim, 8 Drawing Figures



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SHEET 1 OF 3

Fig. 1

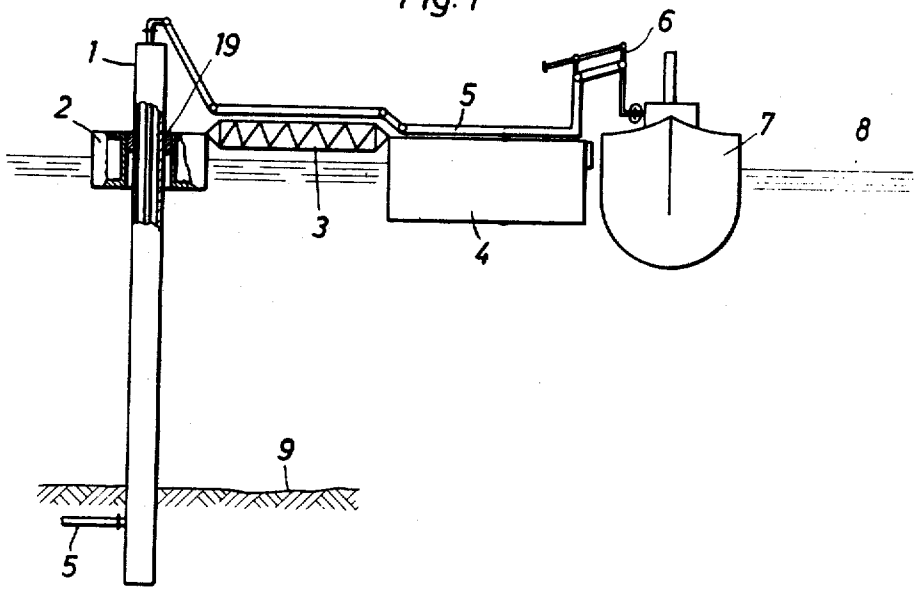


Fig. 2

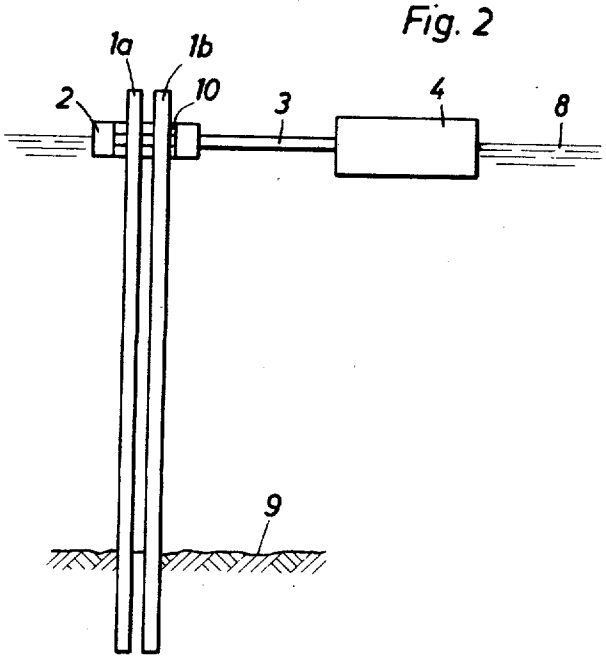
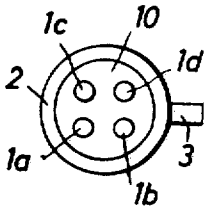


Fig. 3



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Fig. 4

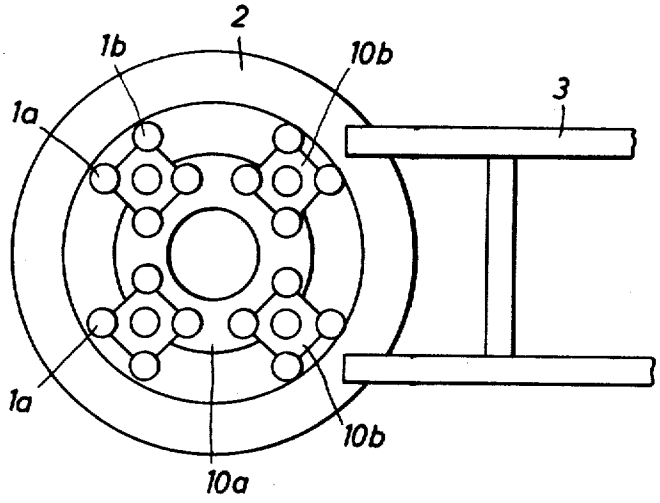


Fig. 5

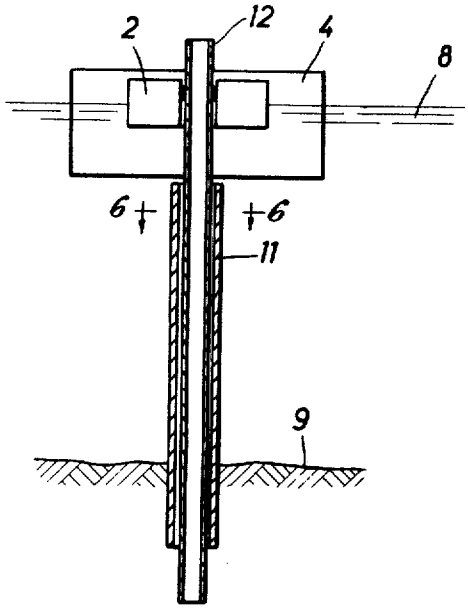
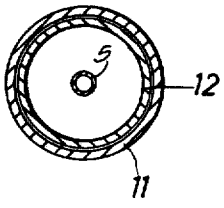


Fig. 6



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Fig. 7

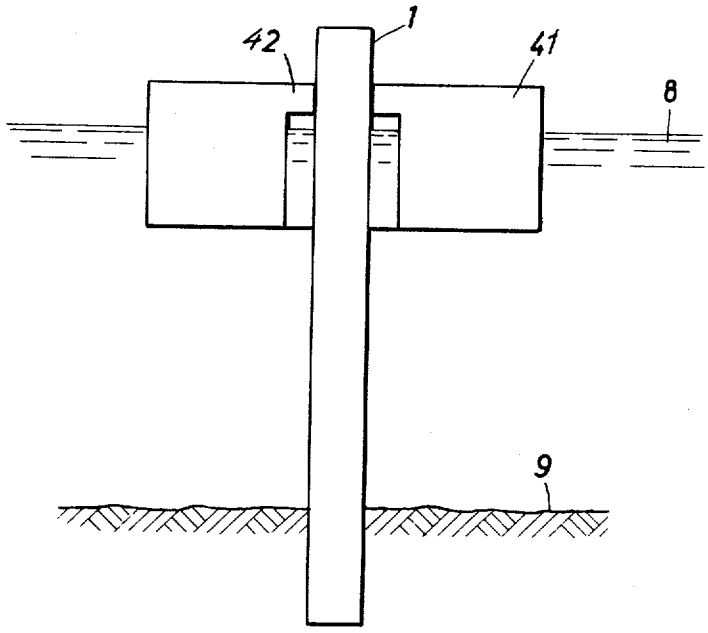
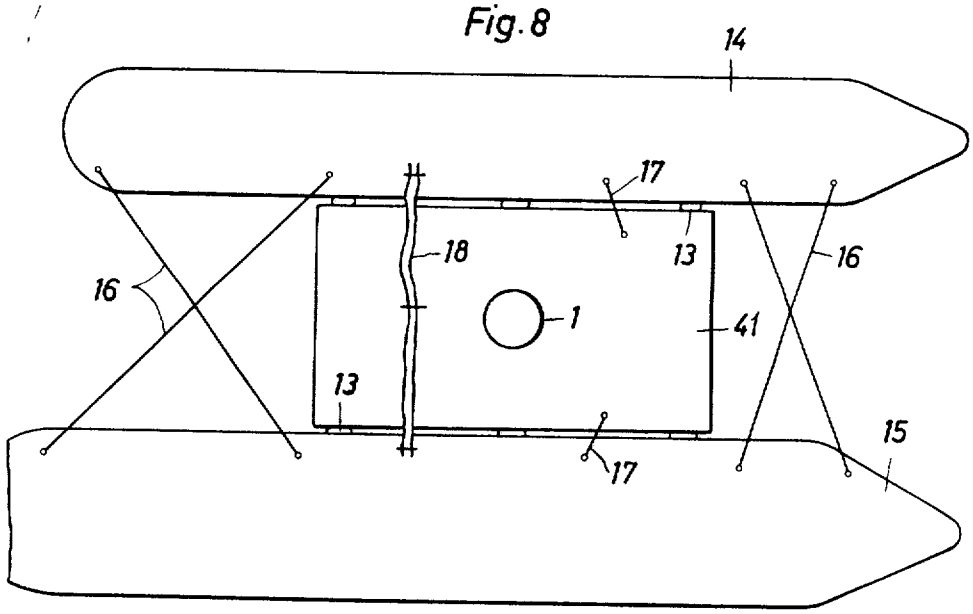


Fig. 8



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OFFSHORE TERMINAL

The present invention relates to offshore terminals for loading and unloading of tankers or for transloading cargo from one ship to another one, in the open sea. More particularly, the invention relates to offshore terminals of this type comprised of a tower that is anchored in the sea floor and serves as stationary reference structure.

A float is linked to that tower for pivoting or turning by 360°. An underwater pipeline runs from shore to the tower of the terminal, through the tower, and terminates in suitable means for providing fluid conductive connection to a tanker. Such offshore terminals are usually located in the immediate coastal regions, where the ocean depth is about 100 feet. Their principle function is to service large tankers having a draft which does not permit them to enter every harbor.

A known terminal of this kind is shown in "Erdoel-Zeitschrift," Oct. 1964, issue No. 10, page 390. This particular terminal has a rigid tower that stands on the bottom of the ocean. An outrigger is linked to the upper end of the tower, which outrigger may turn by 360°, and a rather long latticed girder bridge has one of its ends suspended from that outrigger. A float is connected to the other end of the bridge and is equipped with means for loading and unloading of a tanker.

Large tankers are constructed today in excess of a quarter of a million deadweight tons, so that an offshore terminal must be constructed for corresponding heavy duty.

Particularly, the terminal is to take up the hawser forces that may be exerted by a moored tanker; also, the terminal may occasionally be hit by a tanker which is maneuvered somewhat incorrectly; finally, a frequently heavy sea wears on the terminal.

The above-mentioned literature citation shows, on page 389, a buoy that has been developed to service tankers of up to 100,000 deadweight tons. This buoy is anchored to the bottom of the ocean by means of chains and may, thus, evade impact to some extent.

The offshore terminal that is the object of the present invention must be capable of taking up hawser forces of a moored tanker, and should also be rather insensitive to impacts. In accordance with the present invention, it is suggested to construct the tower, so as to yield and bend resiliently upon impact. Thus, resilient anchorage is provided, capable of absorbing kinetic energy by elastic deformation, resembling somewhat a resilient mooring post.

In one form of practicing the invention, the tower is constructed as a resilient steel pipe. In another form, several tubular posts are driven into the ocean floor and are loosely coupled together near their upper ends. The choice of a single steel pipe or of plural steel pipes for a tower construction depends upon its working capacity, upon the engeneering conditions, possibilities and limits, as well as upon the environment generally. The required strength of the tower depends upon the maximum size tankers it is to service and which may accidentally impact. Thus, a single pipe tower may not be strong enough, particularly if one considers that in cases the water may be rather deep, and the pipe for a single pipe tower may be too heavy to install, possibly exceeding the lifting power of available floating cranes or the like. As sufficiently high powered pile driving equipment is not always available, it may be easier to drive several smaller pipes into the sea floor rather than attempting to drive a single pipe of relatively large diameter.

For very large offshore terminals, a further feature of the invention is particularly suitable. A relatively large number of steel pipes is organized in groups which are regularly arranged around the center axis of the tower to be constructed. The pipes pertaining to a group are rather loosely interconnected, and the groups are also loosely coupled to each other. It has to be observed that the moment of resistance of the tower as to bending must be uniform as an impact may occur from any direction (in the horizontal). The resilient tubing as used for tower construction may be concentrically arranged, whereby strength, particularly the elastic limit of the outer pipe or

pipes, is higher than of the inner pipe or pipes, there may be a stepwise increase in the elastic limit from the innermost pipe to the outermost pipe.

The floating platform serving as docking berth for the terminal may be connected to the tower via a floating collar, either directly or by means of a latticed girder bridge or the like. The floating collar circumscribes the tower. Such a floating collar adapts itself to the changing water level, so that any force acting on the floating platform is imparted upon the tower perpendicular to its vertical axis. The collar is, furthermore, provided at its upper with a fender circumscribing the tower facing it in inward direction. Any force acting on (or transmitted upon) the collar, acts upon the tower via the fender. Thus, any force imparted upon the terminal, for example, via the hawsers of a tanker moored to the terminal, and any impact upon the platform is transmitted upon the tower exclusively through that fender.

Forces should always act as close to the top of the tower as possible, even if the water level changes. Thus, the collar may be controlled as to its buoyancy. For this, the collar is constructed as a floatation chamber constituted by a single, ring-shaped tank, or it may be compartmentalized. These buoyancy tanks may be selectively flooded or blown to establish the desired level for the collar. The collar may actually be a part of the floating, working platform so that this particular embodiment resembles a resiliently anchored buoy.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed that the invention, the objects and features of the invention and further objects, features and advantages thereof will be better understood from the following description taken in connection with the accompanying drawings in which:

FIG. 1 illustrates somewhat schematically a side elevation of an offshore terminal serving as docking berth for loading and unloading of tankers, wherein a large steel pipe is used as anchored tower and reference point;

FIG. 2 illustrates a similar elevation of an offshore terminal with plural steel pipes;

FIG. 3 is a top view of a portion of the terminal shown in FIG. 2;

FIG. 4 illustrates a top view of the tower portion of an offshore terminal with a relatively large number of individual pipes;

FIG. 5 illustrates an offshore terminal, modified in comparison with FIG. 1 with plural, telescopic anchoring pipes;

FIG. 6 is a section view along lines 6—6 in FIG. 5;

FIG. 7 is a side elevation of another offshore terminal in which the floating working platform is centrally traversed by a single pipe tower; and

FIG. 8 illustrates a top view of the offshore terminal of FIG. 7.

Proceeding now to the detailed description of the drawings, in FIG. 1 thereof is illustrated an offshore terminal for loading and unloading tankers such as tanker 7. The installation comprises a central tower constituted presently by a steel pipe 1 which is anchored in the bottom 9 of the ocean. A floating collar 2 circumscribes pipe 1 where traversing the water surface level 8. A latticed girder bridge 3 has one end connected to collar 2, while the other end of the bridge connects to a floating, working platform serving as docking berth. A fender-like projection 19 is disposed between pipe 1 and collar 2. The fender 19 may be secured to collar 2 and act as part of a journal, permitting collar 2, bridge 3 and platform 4 to turn by 360° on the axis of pipe 1.

A conduit system 5 or pipeline system 5 runs from suitable facilities on shore as underwater pipeline to the tower. The pipeline runs through the pipe 1, across bridge 3 and terminates on floating platform 4. The pipeline 5 terminates particularly in means 6 for connection to the tanker. The particular means 6 may include oil delivery equipment to charge the tanker with oil that is being pumped to the terminal via pipeline 5. Alternatively, the means 6 may receive oil from the

tanker for piping the oil to shore facilities. The pipeline **5** where traversing tower pipe **1** should have sufficient distance therefrom so that, upon impact, pipeline **5** will not rupture. Flexible connections in the pipeline, e.g., on bridge **3**, and/or yielding support on the platform etc., render the conduit means yielding in case of impact upon the platform. The collar **2** is constructed as a floatation body, constituting a single ring-shaped tank or a compartmentalized tank, the resulting plural tanks being arranged around the axis of pipe **1**. The tanks may be selectively flooded, partially or completely, or they may be blown to adjust the buoyancy of the collar. The equipment for flooding the tank or tanks in the collar and for pumping water out of them is conventional. By operation of this buoyancy control of the collar, fender **19** will be located always close to the top of the tower. Any impact upon components **2**, **3** and **4** is thus transmitted upon and reacted into the tower by fender **19** as high as possible, so that bending of the tower on a per unit length basis (height) is minimized.

Turning now to the embodiment of FIGS. **2** and **3**, the tower illustrated therein is comprised of a plurality of smaller pipes, such as the four pipes **1***a*, **1***b*, **1***c*, and **1***d*, which are interconnected by coupling structure **10**, but that interconnection is a rather loose one. The coupling structure **10** resembles the bracing structure used for multiple mooring posts. The bracing structure **10** is particularly provided in the present tower structure so that in case one pipe bends, the others can follow and can likewise bend freely, i.e., independently. A somewhat larger floating collar **2** circumscribes particularly the coupling and bracing structure **10**. In case of buoyancy control of the collar, that structure follows the up and down displacement. This embodiment shows also a somewhat simplified girder bridge **3**, and a floating working platform **4**. Suitable pipeline means may run through either or all of the tower pipes **1***a* etc., or through the center of the pipe arrangements.

A particular powerful and strong tower is shown in FIG. **4**, as that particular tower is composed of 20 individual pipes **1***a* through **1***u*. These pipes are organized in four groups of five pipes each. The pipes of each group are interconnected by coupling structure **10***b*, and the several groups, in turn, are interconnected by coupling structure **10***a*. All of the pipes are again surrounded by a floating collar **2** to which is linked a girder bridge **3** etc.

The embodiment of FIGS. **5** and **6** includes a central pipe **12** jacketed in a casing **11**. The two tubular telescopic elements **11** and **12** have different elastic limits, outer casing **11** having a higher elastic limit than inner pipe **12**. Again, there is a floating collar **2**, with fender **19**, a girder bridge (not visible in FIG. **5**) and a floating platform **4**. Also, as shown only in FIG. **6**, the inner pipe is traversed by the pipeline **5**.

The embodiment of FIGS. **7** and **8** shows a central tower that may be constituted by a single pipe **1**, just as in FIG. **1**, but the floating platform **41** in this case, is particularly constructed so as to include a collar **42** which is traversed by the pipe **1**. The particular collar portion **42** may not necessarily itself float in this case, but the main platform may be regarded as including the pivoting collar, so that in that sense the collar is a floating one. The pipe **1** is on a horizontal center line of floating platform **41**, and two tankers, **14** and **15**, can be serviced simultaneously. Fenders **13** attached to platform **41** serve as spacers between the tankers and the floating platform. The tankers are moored to each other by means of ropes **16**. Additional ropes tie the tankers to docking berth **4**. As schematically indicated, a hose **18** is provided to pump oil from one ship to the other one.

The invention is not limited to the embodiments described above but all changes and modifications thereof not constituting departures from the spirit and scope of the invention are intended to be included.

We claim:

1. An offshore terminal for loading and unloading of tankers for aiding in the transfer of cargo from vessel to vessel or the like, and including a resilient tower, a floating platform, loading equipment, and a pipeline in the tower, comprising:

the tower constructed from a plurality of resilient steel pipes anchored to the ocean floor and projecting above the water surface;

the steel pipes resiliently yielding and bending upon impact;

the steel pipes arranged in groups around a vertical center of the tower;

a plurality of first means, each for loosely intercoupling the steel pipes of a group;

second means for intercoupling the first means of the plurality; and

a floating collar circumscribing the steel pipes, for pivotally linking the platform to the tower for pivoting by 360°, the platform, when impacted by a vessel, transmitting such impact upon the groups of resilient pipes.

* * * * *