United States Patent

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[54] **INFLATABLE MARINE FENDER**
7 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **61/48,** 114/219
[51] **Int. Cl.** **E02b 3/22**
[50] **Field of Search** 61/46, 48; 114/219, 220; 256/1

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ABSTRACT: The invention relates to an inflatable fender for a marine structure, being so carried on the latter to receive and absorb the shock of a floating vessel or other object as the latter makes contact with the structure. The fender includes a shock-absorbing element adapted to not only absorb the impact of the floating body but to dissipate the force of the impact and recover for a subsequent impact. A second, supporting element includes an inflatable belt of sufficient length to surround a platform support leg. The support element includes an expandable wall which, upon inflation, extends laterally to form an annular, tight grip against the outer surface of the support leg. Thereafter with the fender supported in place, the shock-absorbing element can be provided for as needed.

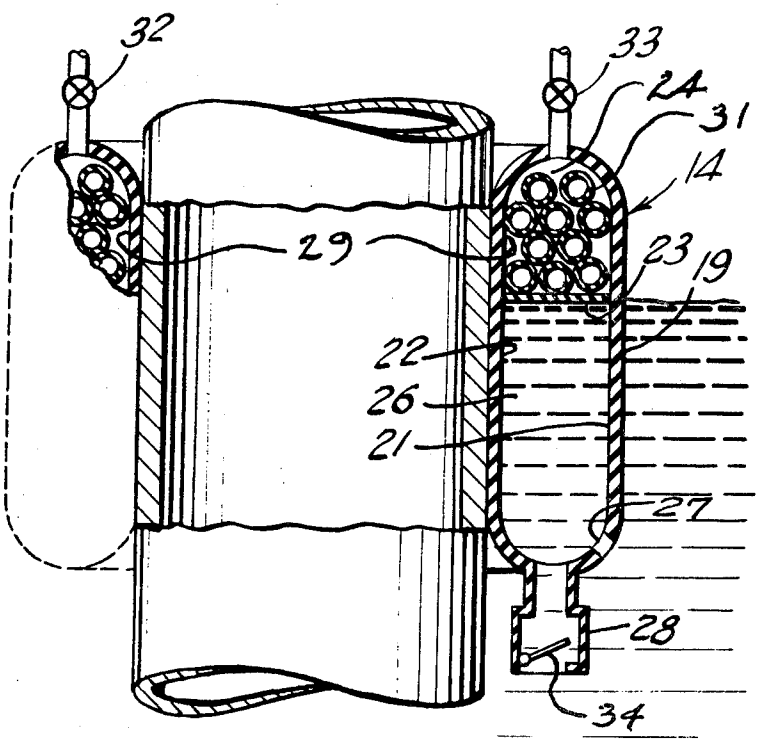


Fig. 1.

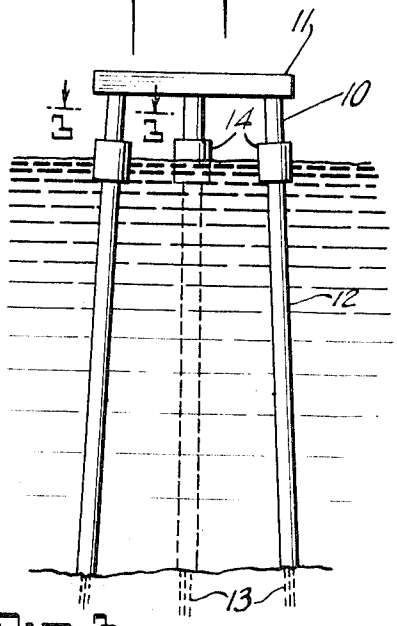


Fig. 2.

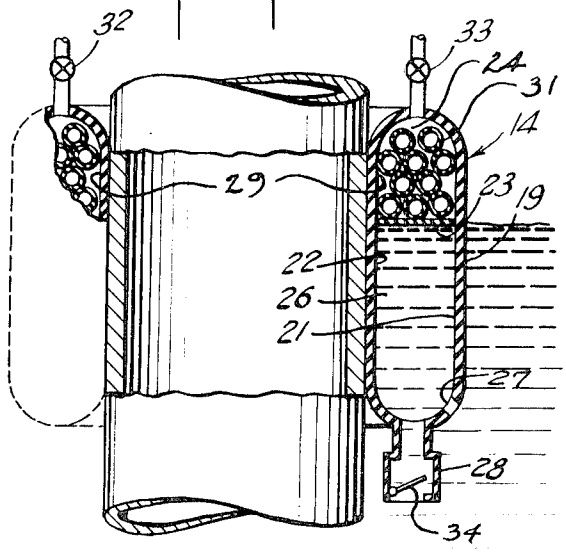


Fig. 3.

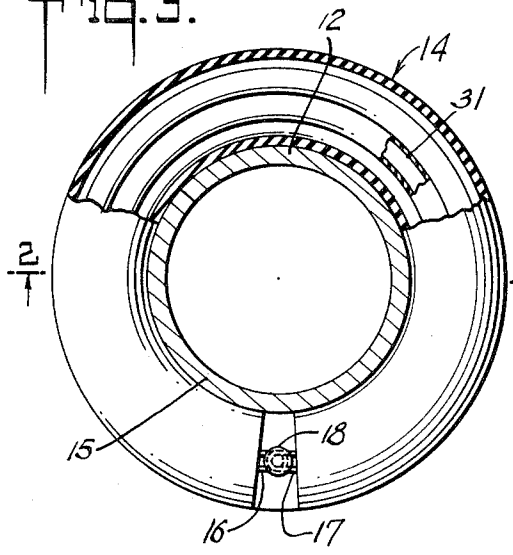


Fig. 4.

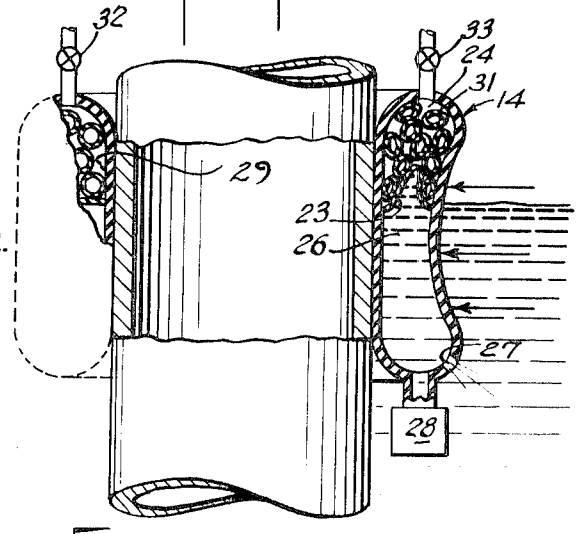
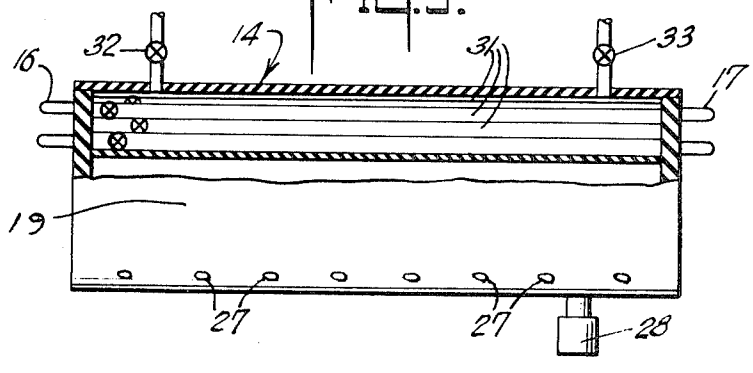


Fig. 5.



INFLATABLE MARINE FENDER

BACKGROUND OF THE INVENTION

In any offshore structure, such as a petroleum well drilling or producing installation, the supporting members thereof which extend into the water are susceptible to damage by contact with ships or other floating objects approaching the platform. In normal service, such platforms are of necessity frequently contacted by supply boats, tankers and other craft in the course of operation. The use of fenders and other protective means on offshore platforms is common, and a virtual necessity. However because of the condition of the water and the weather, and regular usage, such fenders are often damaged to the point of necessitating replacement or repair.

Removal and replacement of a fender can be a relatively simple operation under the proper circumstances. On the other hand in the instance of inclement weather, turbulent waters, or even the periodic changing of the tide and constantly running seas, the positioning of a fender at the water level can be an expensive and time-consuming task. Under such circumstances it is appreciated that the same conditions suggest such replacement to be dangerous to personnel as well as equipment.

In the instance of leg supported marine structures, it is economically feasible to provide each leg with an individual fender rather than providing a unit that extends at the water line to cover a substantial length of the platform. While such units provide protection to the respective legs, the above noted operational problems of installing and subsequently replacing such fenders are greatly multiplied.

OBJECTS OF THE INVENTION

It is therefore one of the objects of the invention to provide a fender for marine structures adapted to facilitate ease in installation and removal. A further object is to provide a fender of the type described embodying self-supporting means on a marine platform leg to facilitate the installation thereof. A still further object is to provide a marine fender for use on a partially submerged support structure, which fender is rapidly inflatable to assume a rigid position with respect to the leg. Still another object is to provide a fender embodying a durable shock-absorbing media that will retain its effectiveness in spite of damage to the fender itself. Still another object is to provide a durable marine fender of relatively simple construction as to be readily applied to or removed from an offshore structure quickly and easily.

In overcoming the foregoing problems, and in achieving the noted objectives, there is disclosed a fender for a marine platform adapted for use particularly at a location where inclement weather is experienced and turbulent seas are common. The fender includes a shock-absorbing and dissipating chamber holding a fluid such as water which will cushion the blow of a floating body urged forcefully against the platform. Said chamber is supported in place by an annular inflatable belt that circumvents the leg member to be protected. Said belt is inflated in place on the leg to form a peripheral grip sufficiently tight to stabilize the fender's position. Thereafter the unit may be more permanently fastened or further prepared for operation by filling with a resilient shock-absorbing material.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation view of a marine platform anchored in a body of water and including a fender of the type hereinafter disclosed, connected to each of the platform legs. FIG. 2 is a segmentary view taken in cross section and on an enlarged scale along line 2–2 of FIG. 3. FIG. 3 is an enlarged plan view in partial cross section taken along line 3–3 of FIG. 1. FIG. 4 is a view similar to FIG. 2 illustrating the partially submerged fender in a deformed condition as a result of being contacted by a boat or other floating body. FIG. 5 is a vertical elevation in partial cross section of the fender shown in the above noted figures prior to the fender being wrapped about a platform leg.

Referring to FIG. 1, in the illustrated embodiment of the invention, there is shown an offshore marine platform 10 of the type contemplated. A working deck 11 is supported a predetermined height above the water's surface either movably or stationarily by a plurality of downwardly extending legs or columns 12. The lower ends of the respective columns 12 are submerged, and fastened into the under water substratum by piling 13, anchors or similar means. The upper ends of the elongated legs are normally operably registered in a leg jacking mechanism, not presently shown, at deck 11. Such mechanism however normally functions to adjust the vertical orientation of the deck with respect to the water's surface for floating the deck or for raising it to a working position.

The embodiment of the marine platform shown is illustrative of the type which fastens to the substratum by one or more elongated legs 15. In this instance three legs are utilized, however the actual number required is indefinite, depending on the loading conditions imposed by the deck, the water depth, and similar factors.

A shock-absorbing fender 14 is carried on each leg at the interface of the water and the atmosphere to receive the force of a vessel moving against the legs. It is appreciated that variations in the water level induced by tidal action at a particular location and turbulence of the water due to storm and wave conditions, the fender will be relatively wide in height to provide adequate protection to the platform legs under all conditions to which the platform is subjected.

Referring to FIG. 2 which illustrates fender 14 in assembled condition, said fender includes in essence an outer casing 19 formed of a resilient material such as rubber, Neoprene or the like. The casing is imbedded with a reinforcing element such as metallic fibers, wires and the like to afford the unit needed toughness as well as durability. The reinforcing medium is oriented in a direction to permit restrained inward deformation of the casing outer wall as shown in FIG. 4, when said unit is subjected to the lateral force of a floating object coming into contact therewith at or near the water's surface.

The disclosed fender 14 can be utilized on various forms and configurations of marine structures and supports. However, for the purpose of illustrating the features of the invention, the apparatus is here described in conjunction with the shown offshore platform which rests on elongated cylindrical support legs 12 anchored at their lower ends to the ocean floor. Further, fender 14 can be rigidly fixed to the leg surface, or it can be slidably carried thereon whereby the fender will have a degree of freedom to adjust in response to variations in the water level.

Referring to FIG. 5, fender 14 when in the deflated condition, comprises a flat beltlike arrangement formed by the flexible casing 19. Each of the casing opposed ends is provided with joinable coupling means such as connectors 16 and 17, which connections are joined in the manner shown in FIG. 3 as by inserting a connector pin 18 through the aligned connector halves. The connectors are spaced vertically apart to provide the desired uniformity and strength to the fender.

Casing 19 is fabricated or adjusted prior to installation such that in the wrapped-around assembled condition, the respective end connectors 16 and 17 will be aligned and in registry to provide a close fit of the belt against the outer surface of the leg 12.

Casing 19 is formed with opposed sidewalls 21 and 22 of a flexible, corrosion resistant, yet durable material. A diaphragm 23 extends longitudinally the length of the casing 19, being sealably joined at the opposed sidewalls thereof whereby to form segregated fluidtight compartments 24 and 26. When the fender is assembled to a platform leg, lower compartment 26 is at least partially submerged thus holding a quantity of sea water with the casing walls in a generally upright disposition. Means is provided in lower compartment 26 to permit a metered escape of water when external wall 22

of compartment 26 is collapsed inwardly under the force of a floating object. The compressed water is urged thus from compartment 26 through escape means such as apertures 27 formed in the walls of casing 19.

For example, the compartment 26 can be provided with a plurality of constricted openings which open either into the surrounding water or into the air. Also, said compartment 26 may be communicated with a valved conduit in which the valve member is adjusted to permit only a regulated waterflow therethrough whereby to form rapid flow jets to dissipate the energy of the casing deformation.

After being partially evacuated as the casing 19 is collapsed, compartment 26 is rapidly refilled through a valved inlet means. The latter includes a conduit 28 having a submerged inlet 29, together with a check valve 34 disposed in the flow passage. On the discharge cycle, check valve 34 adjusts to a closed position thereby permitting water to discharge under pressure only through the respective apertures 27. During the refill cycle, reduction of the internal pressure within compartment 26 permits check valve 34 to open thereby admitting a flow of water in sufficient quantity to substantially replenish compartment 26.

The pressurized outflow of water in jet form in effect dissipates the otherwise crushing force of a floating vessel as the latter moves against and collapses the resilient fender casing 19. While not presently shown, casing 19 may further include biasing means such as spring members either incorporated within the compartment proper, or incorporated into the casing wall 22 to assist the latter in returning to its uncompressed disposition in anticipation of absorbing a subsequent forceful contact with the vessel.

During the initial or discharge cycle when compartment 26 is deformed to a constricted configuration (FIG. 4), the collapsing force against wall 22 will not only deform casing 19 but will also urge diaphragm 23 into the upper or secondary chamber 24. The latter is in turn provided with a resilient medium against which diaphragm 23 is urged, and then forced back into its normal position upon removal of the deforming force.

Compartment 24 is formed initially as a pneumatic chamber defined at least in part by an expandable panel 29 along the fender center opening that will abut a platform leg. Said panel 29 or a portion thereof, is contiguous with the leg outer surface when the fender is fastened to the leg in deflated condition. Panel 29 is preferably formed of a more yielding material than casing 19 such that it will expand outwardly although the casing retains its shape. Thus, as compartment 24 becomes inflated, flexible panel 29 will be expanded outwardly from the fender sidewall to form a frictiontight grip with the leg 12 surface.

Compartment 24 is provide with one or more valved breather passages 32 and 33 which can be manifolded to a unitary system or can be operated individually. Thus, at the time of installation, the collapsed beltlike fender is placed or lowered about a platform leg at the proper leg height and loosely fastened at couplings 16 and 17. Compressed air is then forced into the compartment 24 with the result that panel 29 expands toward the leg, thereby forming an annular grip on the latter. With fender 14 now fixedly located, even though on a provisional basis, it can be readily worked on by personnel to either rigidize it in place, adjust flotation equipment, or insert cushioning elements into the fender.

Referring to FIGS. 2 and 4, compartment 24 is further provided with a yieldable component against which the diaphragm 23 is displaced. As shown, compartment 24 encloses a combination pneumatic and mechanical means in the form of a plurality of elongated flexible wall conduits 31 arranged longitudinally of the fender to substantially completely fill said compartment. Conduits 31 may be sealed at the respective ends to form a closed gas-holding cell, or they may be valved at one or both ends to permit a bleeding flow of the confined air or gas at such time as the conduits are compressibly deformed. The bleeding feature in conduits 31 assures consistency in operation of the fender regardless of atmospheric changes such as changes in temperature which would otherwise alter the characteristics of confined air, and consequently alter the performance characteristics of the fender 14.

In one embodiment, elongated conduits 31 are formed of a reinforced resilient material such as reinforced rubber, Neoprene or the like adapted to be inwardly deformed yet sufficiently resilient to elastically return to their shape. Conduits 31 are formed preferably with a smooth outer surface such that they will adjust not only in sectional configuration but also in their relative disposition with respect to each other as the upwardly deflected diaphragm tends to displace and deform said conduits.

Subsequent to fender 14 being installed on a platform leg 12, as previously mentioned it may be fixedly fastened in place or otherwise retained in an alterable disposition. From a practical point of view, fender 14 can be placed and secured in the collapsed condition about a platform leg, then lowered into place from the platform deck 11. Hoses connected to passages 32 and 33 are connected with a source of high-pressure air at the deck through appropriate valve means to regulate the flow of said inflating air. Thereafter, at the proper leg height, rapid inflation of compartment 24 will cause panel 29 to expand outwardly and lock the fender in place. Because of the ease and brevity of the operation it may be carried out in all sorts of inclement weather, or in spite of the condition of the seas about the platform which would otherwise cause the fender to oscillate in a continuous vertical motion thereby making work on the fender difficult and hazardous.

However, with the self-sustaining feature in effect, the stationary fender may be provided with a cushioning material in either or both compartments 24 and 26 such as an expanded filler or other more commonly known material as rubber, cork, etc.

In the course of constant use, should upper chamber 24 lose its air tight integrity due to wall damage or other exigency, operation of the fender will not be hampered since the elongated conduits 31 will still be functional in absorbing the upward force of the diaphragm as the latter is displaced into said chambers.

Obviously many modifications and variations of the invention, as hereinafter set forth, may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. Fender for a marine platform positioned in a body of water which platform includes a work deck, a support structure for said deck having a support leg at least partially submerged beneath the water's surface, said fender including;
   a. a closed casing depending from and surrounding the outer surface of said leg at the water's surface and having at least a portion thereof submerged beneath said surface,
   b. means forming an inflatable chamber adjacent the interface of said casing and said leg,
   c. means communicating said inflatable chamber with an inflating medium for expanding said chamber inwardly toward the wall of said support leg whereby to frictionally position said fender on said leg,
   d. said closed casing including a diaphragm disposed therein and extending throughout the length thereof thereby forming said casing interior into said upper inflatable chamber and a lower shock-absorbing compartment.

2. In a marine fender as defined in claim 1 wherein said upper inflatable chamber includes breather means communicated therewith.

3. In a marine fender as defined in claim 2 wherein said upper inflatable chamber includes a yieldable element substantially the same and being in engagement with said diaphragm for yieldably resisting movement of said diaphragm into said inflatable chamber in response to a compression of said lower compartment.

4. In a marine fender as defined in claim 3 wherein said yieldable element includes a plurality of elongated, flexible wall cells substantially filling said chamber and being elastically yieldable in response to movement of said diaphragm thereagainst.

5. In a marine fender as defined in claim 4 wherein said yieldable element includes a plurality of elongated conduits extending axially of said fender and confining a gaseous medium therein.

6. In a marine fender as defined in claim 5 wherein said elongated conduits are open ended thereby permitting the free flow of said gaseous medium therethrough.

7. In a marine fender as defined in claim 5 wherein said elongated conduits include valve means therein forming a closure to said flexible wall cells whereby to regulate the passage of said gaseous medium therethrough.