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(54) Titre: Dual function mooring lines for storage vessel.

(57) Abrégé:

An improved vessel mooring system in which a storage vessel (10) weathervanes about a mooring base (16,27) supported by the vessel for relative rotation. A plurality of flexible tubular dual function mooring lines (20) extend from the mooring base (27) to the sea floor (14) and thence to a subsea production facility (40). The dual function mooring lines (20) have collars (34) thereon which are anchored to the sea floor (14) by anchors (38). Product from a subsea production facility (40) is transported through the dual function mooring lines (20) to storage areas in the vessel (10).

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APPLICATION FOR PATENT

FOR: DUAL FUNCTION MOORING LINES FOR STORAGE VESSEL

BACKGROUND OF THE INVENTION

Cross-Reference to Related Provisional Application

This application claims the benefit of U.S. Provisional Application No. 60/020,005 filed June 21, 1996 and entitled Mooring Lines For Storage Vessels.

Field of the Invention

5 This invention relates generally to a mooring system for floating storage vessels, and more particularly to mooring lines for floating storage vessels which may be used simultaneously for the transfer of fluid product.

Description of the Prior Art

10 Floating storage vessels for petroleum products are normally moored in the sea by mooring lines anchored to the sea bed. The mooring lines are normally secured to a turret mounted in a moon pool or opening in the vessel so that the vessel may rotate or "weathervane" about the turret. Separate risers extend from subsea wells or manifolds to the storage vessel for the flow of product from the subsea wells to the storage vessel. The risers are flexible and are connected to corresponding piping in the turret which
15 extends to a manifold. A swivel stack is provided on the vessel with a separate product line from the turret manifold extending to a swivel chamber of each swivel for product supply to storage holds in the vessel. As examples of turrets, reference is made to United States Patent Nos. 4,698,038 dated October 6, 1987 and 5,306,186 dated April 26, 1994, which are incorporated herein as a written description for all purposes. In regard to swivel
20 stacks, reference is made to United States Patent Nos. 4,306,741 dated December 22, 1981 and 4,647,077 dated March 3, 1987, which are incorporated herein as a written description for all purposes.

25 It is becoming commonly accepted practice for floating vessels (tankers, barges, column stabilized units, etc.) to be moored in the open ocean using spread or single point type mooring systems. This is being done using various combinations of chain, wire rope and polyester rope in conjunction with subsurface support buoys to provide mooring systems that are uniquely customized for a specific vessel and environmental conditions

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mooring line illustrating the present invention.

DESCRIPTION OF THE INVENTION

Referring to the drawings, a storage vessel 10 is shown floating on a sea surface 12. The sea bed or sea bottom is indicated at 14. A turret 16 is mounted within a moon pool 18 at the bow of vessel 10. Turret 16 has an upper overhanging portion 25 mounted for relative rotation on suitable bearings 26. Cushioned radial bearings 28 are mounted on the vessel structure adjacent moon pool 18. As shown in Figure 1, a plurality of tubular dual function mooring lines 20 are arranged peripherally in an array about turret 16.

As shown in Figure 3, each flexible dual function mooring line 20 is inserted in a bend restrictor 20A at the lower end 27 of the turret 16, and continues upwardly through structural tubes 100 which encase the risers 20 in the turret 16. The risers 20 are supported above the waterline 12 by support blocks 102. A slip is set in each support block 102 to support the flexible dual function mooring line 20 to the turret. Piping 21 is connected at the upper end of each riser 20 by a standard flange, clamp connector or a QC/DC fitting. Fixed piping 21 is connected to upper piping 23 which extends to manifold 32. Manifolds 32 are mounted on manifold deck 34 which forms part of turret 16. The vessel 10 rotates about turret 16 on vertical bearings 26 and is rotationally cushioned by radial bearings 28.

A swivel stack 30 is mounted above manifolds 32. Swivel stack 30 may include an inner ring structure 29 which is fixed to turret 16 and has a stationary concentric outer ring structure 29 which is fixed to and rotates with vessel 10 about turret 16. Each outer ring of the swivel stack 30 is rotationally coupled to its corresponding inner ring. An auxiliary bearing 36 may be provided to provide additional rotation coupling of the outer rings of the swivel stack to the turret 16. Suitable product flowlines are connected to suitable valves on manifolds 32 and extend within inner ring structure 33. Flowlines 35 are connected to stationary ring structure 29 for the flow of product from swivel stack 30 to suitable holds or storage areas in storage vessel 10. Reference is made to aforementioned United States Patent No. 4,306,741 and 4,647,077 for a description of swivel stacks. As shown in Figure 4, a lower end portion of each dual function mooring line 20 has a collar or coupling 34 connected by a chain 36 to an anchor 38 extending therefrom and embedded in the sea bed 14. While anchor 38 is shown as an embedment type anchor, other anchors or a suitable fixed piling may be provided. Tubular dual function mooring line 20 extends from collar 34 to a subsea manifold or subsea production facility indicated schematically at 40. Such facility may be a subsea wellhead or manifold. Mooring line 20 functions not only to secure the turret 16 to the sea floor 14 but also to transport fluid

and data lines, and conduits 118 for well treatment fluids. The conduits of Figure 5B are embedded in thermoplastic material 20T.

While the embodiment of the present invention has been described for a vessel mounted for rotation about a turret substantially fixed to the sea floor, it is apparent that this invention may find application for any mooring line associated with a vessel in which it is desired to achieve the additional function of transferring fluid product from the sea floor to the vessel. For example, dual function mooring lines as described above may run from a loading buoy to the sea floor to transport product from the sea floor to a surface location.

While the invention has been described in the more limited aspects of a preferred embodiment thereof, other embodiments have been suggested and still others will occur to those skilled in the art upon a reading and understanding of the foregoing specification. It is intended that all such embodiments be included within the scope of this invention as limited only by the appended claims.

8. An improved mooring arrangement for a vessel comprising:
a mooring structure rotationally coupled with said vessel,
a plurality of flexible tubular dual function mooring lines connected to said
mooring structure and extending to subsea production facilities on a sea floor for fluid
communication of product between said subsea production facilities and said mooring
structure, and

anchor means for anchoring said plurality of dual function mooring lines to
said sea floor.

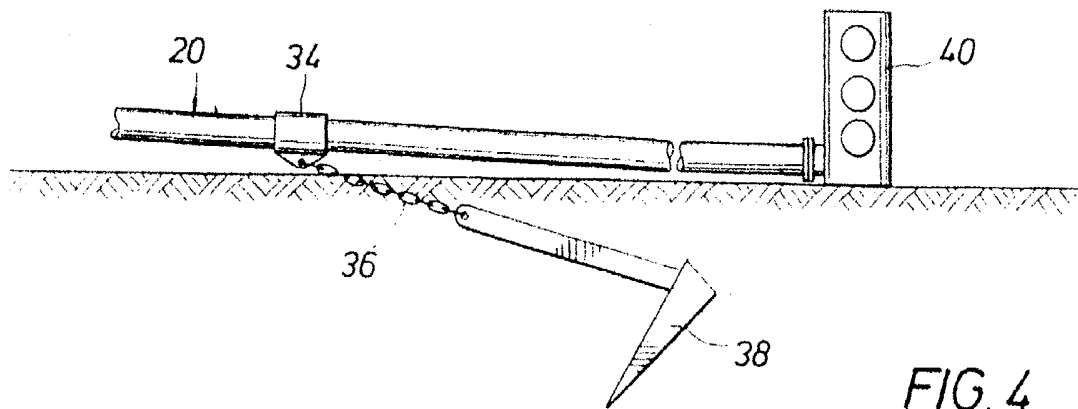
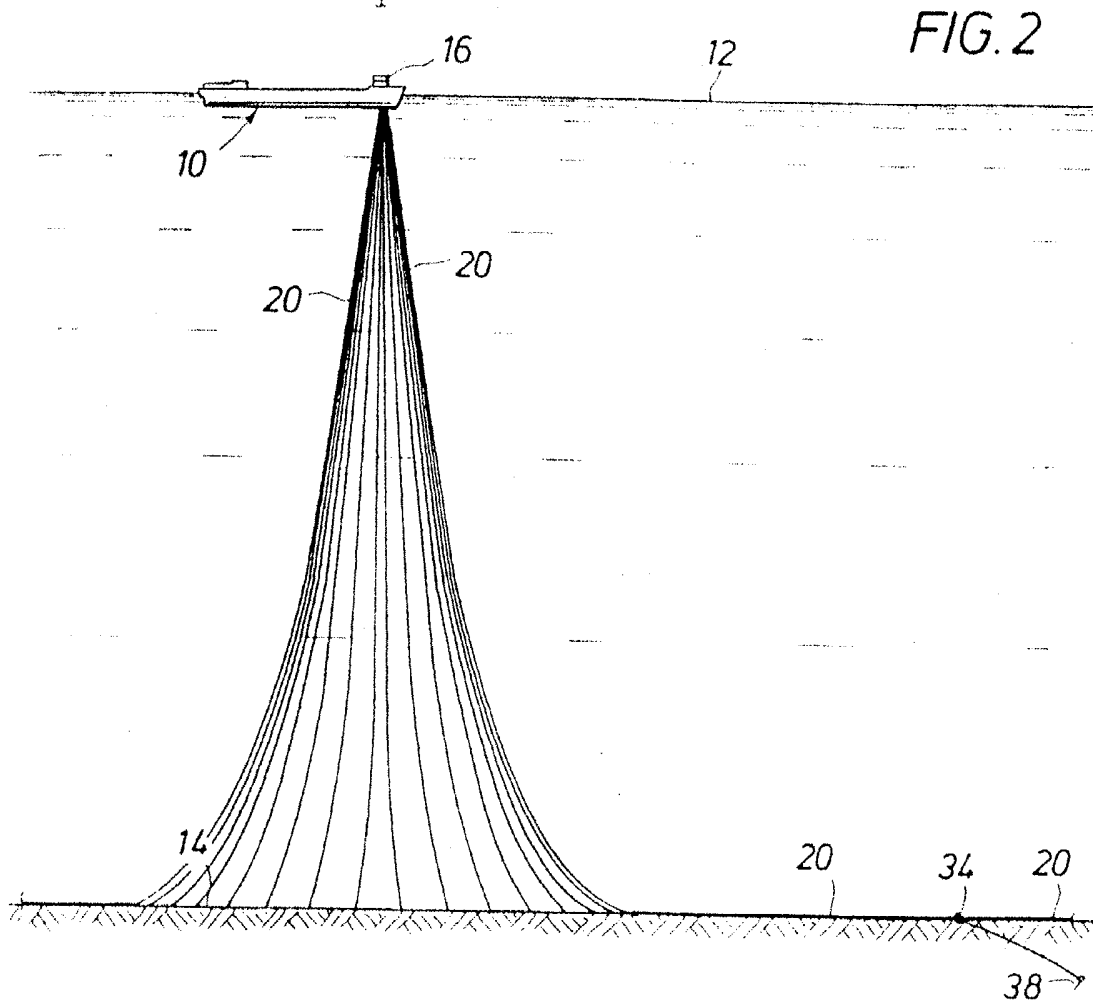
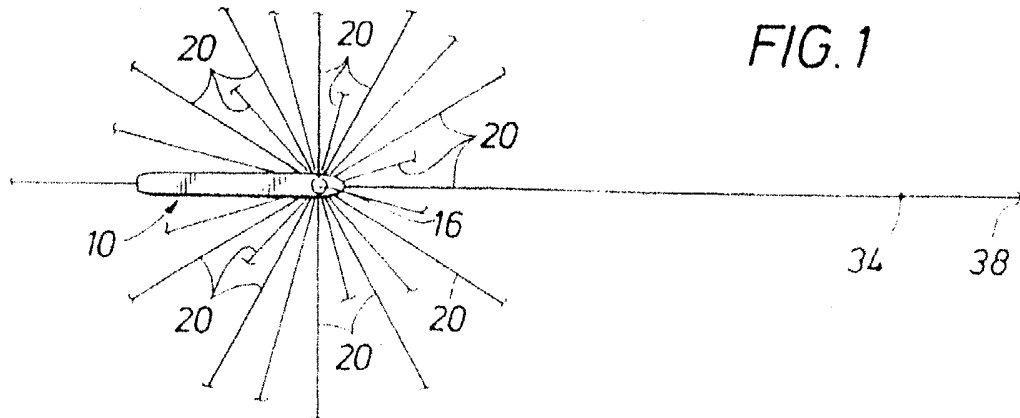
9. The improved mooring arrangement of claim 8 wherein:
product lines on said vessel are in fluid communication with said mooring
lines on said mooring structure to storage areas in said vessel for the transport of product
to said storage areas.

10. The improved mooring arrangement of claim 9 wherein:
a support collar is mounted about each dual function mooring line adjacent
the sea floor; and

said anchor means are anchored to the sea floor and connected to said
support collars for anchoring the mooring lines to said sea floor.

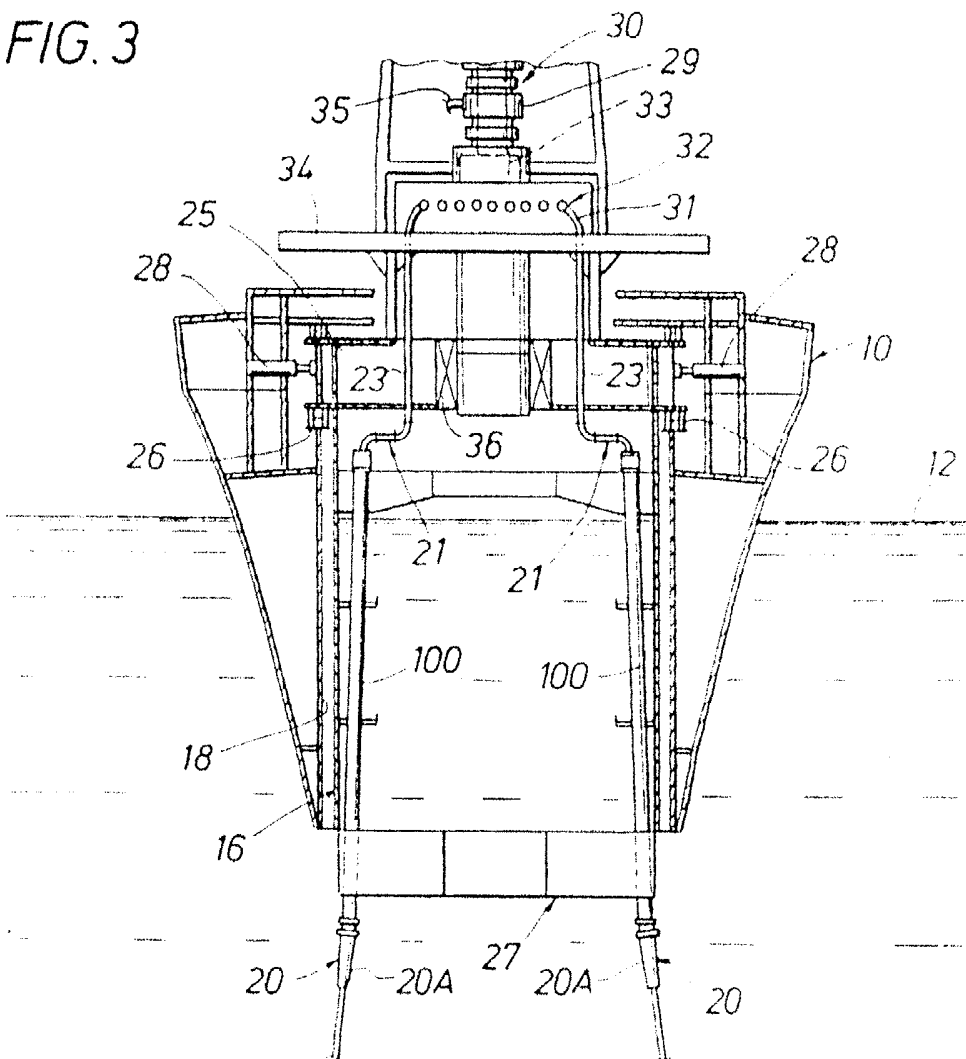
11. The improved mooring arrangement of claim 8 wherein:
each of said dual function mooring lines has an annular wall including a
plurality of thermoplastic layers and a plurality of spirally wound steel layers separating
said thermoplastic layers.

12. An improved mooring arrangement of claim 8 wherein:
a hydraulic fluid line is positioned within at least one of said tubular mooring lines.



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FIG. 3



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FIG. 5A

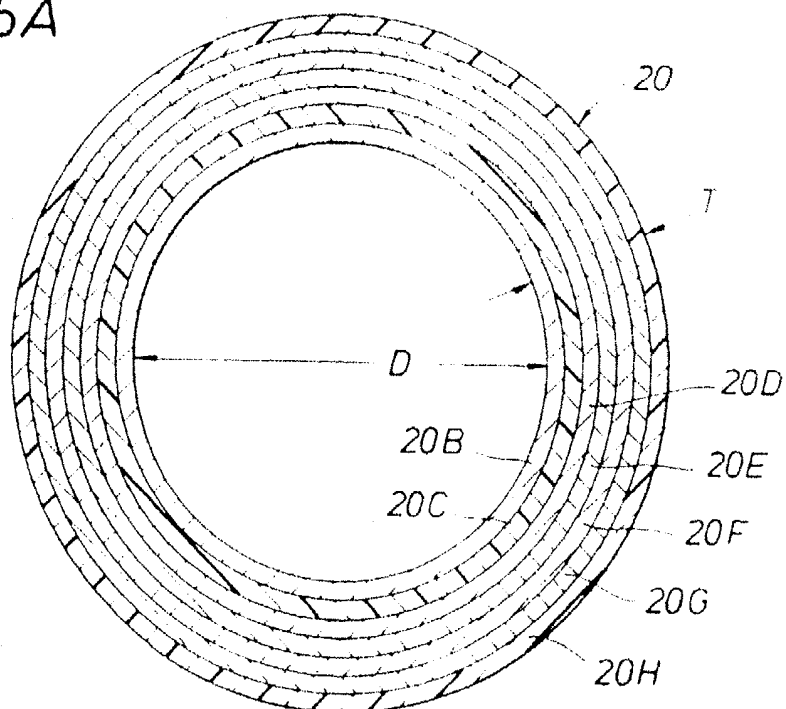


FIG. 5B

