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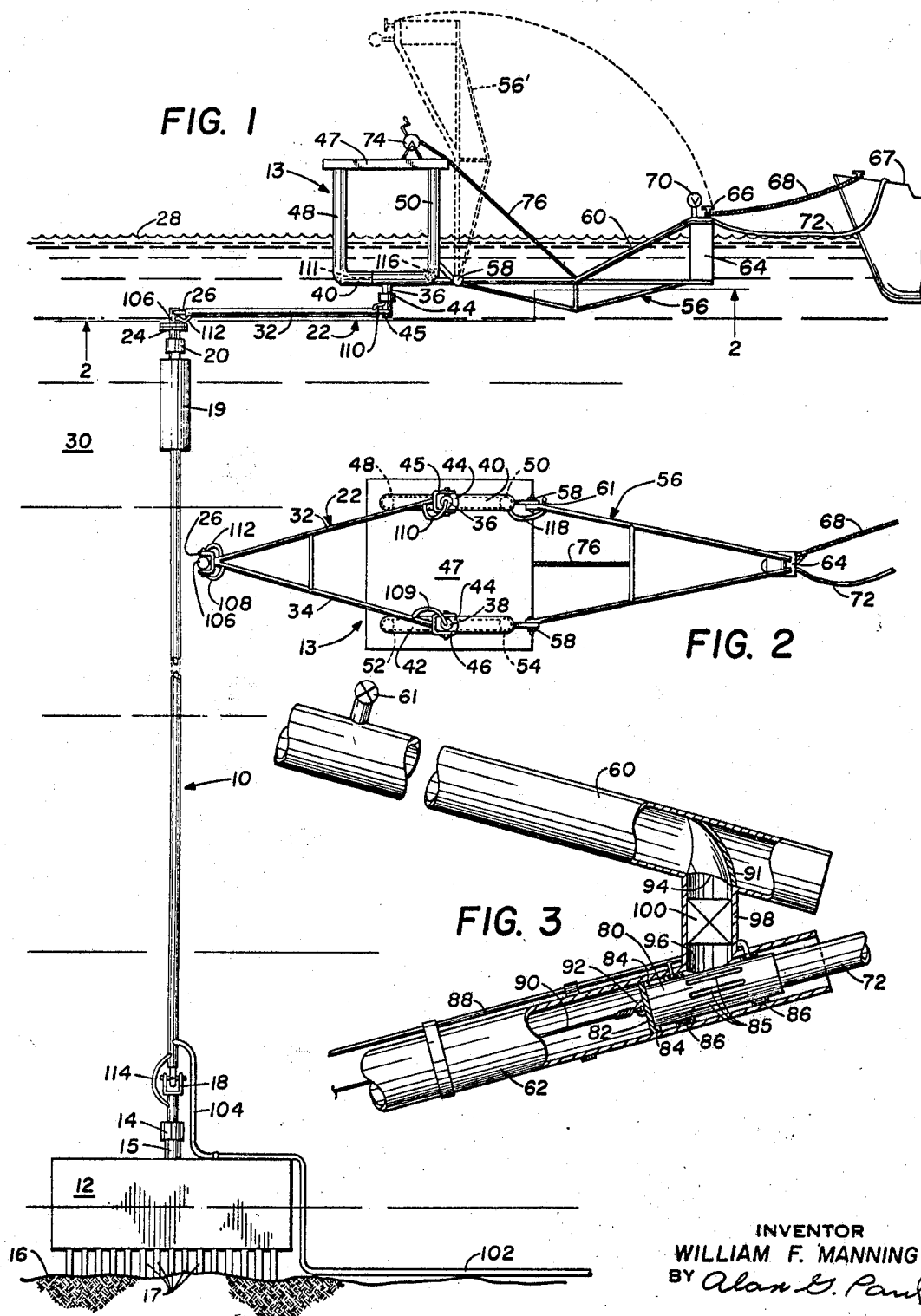
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3,479,673

APPARATUS AND METHOD FOR TRANSPORTING FLUIDS BETWEEN
A SUBMERGED STORAGE TANK AND A FLOATING VESSEL

Original Filed Oct. 25, 1966

2 Sheets-Sheet 1



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FIG. 4

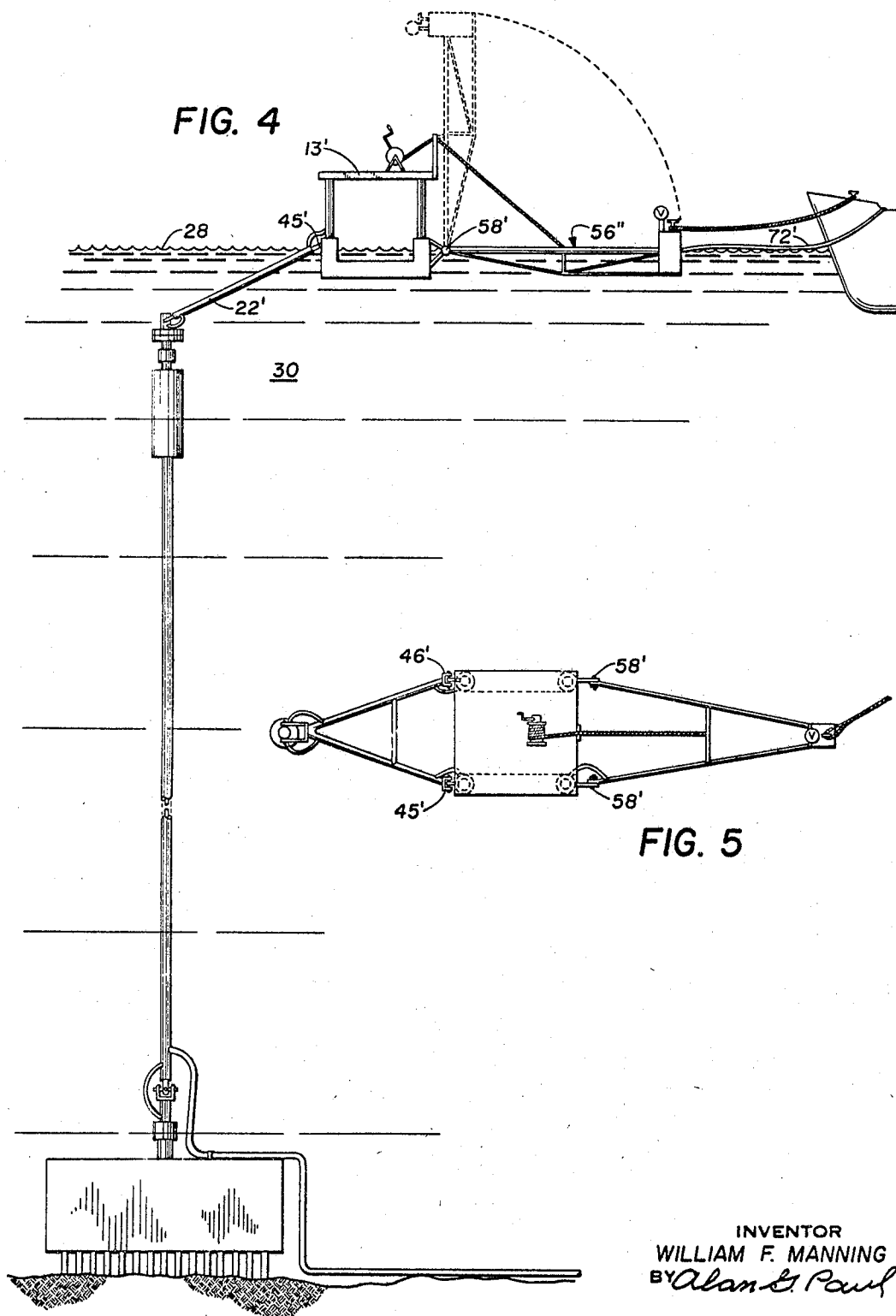
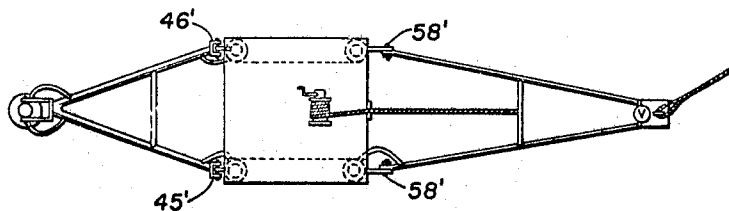


FIG. 5



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APPARATUS AND METHOD FOR TRANSPORTING FLUIDS BETWEEN A SUBMERGED STORAGE TANK AND A FLOATING VESSEL

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Original application Oct. 25, 1966, Ser. No. 589,434.

Divided and this application June 28, 1968, Ser. No. 777,513

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U.S. Cl. 9—8

8 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for the mooring and loading of vessels. A loading boom is pivotally mounted to a floating terminal. The liquid flows through the loading boom. The hose which connects the loading boom with a vessel is retractable into the loading boom.

This application is a division of application No. 589,434 filed Oct. 25, 1966.

The present invention relates to an improved offshore structure for the mooring and loading of vessels, particularly with crude oil and/or liquefied gas accumulated in a submerged storage tank. More particularly, the invention is concerned with the surface and near-surface apparatus of a subsea producing system, a floating offshore terminal, commonly called a "single point mooring system," wherein a vessel, such as a tanker, may be moored in the most advantageous direction, dictated by the wind and waves, during loading.

Present developments in the offshore oil and gas industry indicate that drilling and production efforts will be extended to underwater areas, such as the outer fringes of the continental shelves and the continental slopes (defined as areas where the water depth is over 600 feet and less than 6,000 feet). At such depths, particularly where the subaqueous wellheads can be widely spaced, submarine production systems are presently considered the most practical method of producing hydrocarbons trapped in the subaqueous formations. Submerged storage facilities, able to accommodate at least ten days' supply of accumulated fluid hydrocarbons, are an integral part of the system. With the wellheads, production satellites, gathering systems, and production storage, all being supported on the ocean bottom, perhaps 600 feet or more below the surface, some means is necessary for transporting the accumulated hydrocarbons from these depths to a tanker which periodically visits the area. A single point mooring system is considered the most practical means for accomplishing this result. Such a system generally consists of a surface unit, means for anchoring the surface unit and at least one fluid passage between the surface unit and a submerged storage facility. The surface unit is provided with a central floating terminal and a loading and mooring means connected between the central floating terminal and the tanker. The loading and mooring means is designed to pivot around the terminal so that the tanker may be moored in the most advantageous direction at the time, which would usually be with the bow of the tanker pointed into the wind or waves.

A single point mooring system is also practical in shallower areas where good harbors are not available or where the harbors are so extremely crowded that there is a considerable advantage in being able to load and un-

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load offshore. Furthermore, tankers utilizing offshore loading facilities need not wait for a high tide to enter a harbor, which is the case in many areas of the world. In this instance the single point mooring system could be connected to either onshore or offshore storage facilities.

Accordingly, it is an aspect of the present invention to provide a stable offshore floating terminal, connected to a point adjacent the ocean bottom, for mooring a tanker thereto and transporting fluids between bottom storage facilities and the tanker.

It is another aspect of the present invention to provide an improved means for connecting the floating terminal and storage facilities located at the marine bottom.

It is a further aspect of the present invention to provide a novel boom or support means extending part way between the floating terminal and the tanker to facilitate the tanker being moored at a safe distance from the terminal while being in fluid communication therewith.

Other aspects and advantages of the present invention will be readily apparent from the following description, when taken in conjunction with the accompanying drawings that illustrate useful embodiments in accordance with this invention, in which:

FIGURE 1 is a schematic elevational view of the novel single point mooring system of the present invention;

FIGURE 2 is a partial bottom plan view taken along lines 2—2 of FIGURE 1;

FIGURE 3 is an enlarged partial sectional view of the loading boom of the present invention, as shown in FIGURE 2, illustrating the structure for transporting fluids from the central floating terminal to the tanker through the loading boom;

FIGURE 4 is a schematic elevational view of a second embodiment of the present invention; and

FIGURE 5 is a top plan view of the second embodiment of the present invention.

Now looking at FIGURES 1 and 2, the single point mooring system of the present invention consists in part of a substantially vertical rigid-walled tether pipe 10 bridging the distance between a submerged facility comprising an open bottom storage tank 12 and a surface unit comprising a floating terminal 13. The tether pipe 10 is connected to the storage tank 12 by a collet connector 14 fastened to a short upstanding stub pipe 15 extending from the upper end of the storage tank 12 which is fixed in the formations underlying the marine bottom 16 by a plurality of piles 17. A universal or double pin joint 18, in the tether pipe 10 just above the collet connector 14, allows the upper end of the tether pipe 10 to be displaced from directly above the collet connector 14 without allowing rotation. In very deep water, the universal or double pin joint 18 can be dispensed with, and the inherent flexibility of the pipe can be taken advantage of, the flexibility of the tether pipe being proportional to its length. A buoyancy tank 19 for axially supporting the tether pipe 10 is fixed concentrically thereon near the upper end just below an upper collet connector 20 joining the upper terminus of the tether pipe 10, below the surface 28 of a body of water 30, to the apex of an A-frame forming a submerged tether arm 22 of the floating terminal 13. A concentric swivel joint 24 and a knee-action pin joint 26, in series, just above the collet connector 20, at the apex of the tether arm 22, allow the main portion of the tether arm 22 to be parallel substantially to the surface 28 of the body of water 30 while permitting the tether arm 22 to rotate around and pivot about the center line of the tether pipe 10. At the inner

end of the tether arm 22, a pair of legs 32 and 34 of the A-frame are joined by collet connectors 44 to conduits 36 and 38 depending vertically from the centers of parallel submerged supporting floats 40 and 42, respectively, of the floating terminal 13. The floating terminal 13 is a wave transparent structure consisting of an above-surface platform 47 supported on a plurality of buoyant vertical support column 48-54 which are connected in pairs by the submerged floats 40 and 42. Pin joints 45 and 46 in the legs 32 and 34, respectively, of the tether arm 22, just below the collet connectors 44 provide a knee-action movement between the tether arm 22 and the floating terminal 13.

The arrangement of the components above the swivel 24 allows all of the forced motions of the floating terminal 13. The pin joints 26, and 45 and 46 at either end of the tether arm 22, permit heave of the floating terminal 13 and also pitch in the plane of the tether arm 22. The swivel 24 at the outer end of the tether arm 22 and the universal joint 18 at the lower end of the tether pipe 10 permit the free movement of the floating terminal 13 around the tether pipe 10 and preclude a build-up of forces perpendicular to the plane of the drawing.

A leading boom, generally designated 56, is pivotally fastened to the lower end of the terminal 13 by means of knee-action pin joints 58. The boom 56 consists of a "bent" A-frame having a triangulated framework of support braces. The A-frame has an oil transporting leg 60 and a loading hose storage leg 62 with a flotation tank 64 fixed to the boom 56 at the apex of the legs 60 and 62. In the loading position of the boom 56, as shown in solid lines in FIGURE 1, the outer ends of the legs 60 and 62 of the bent A-frame and the upper end of the flotation tank 64, having an upstanding mooring bollard 66 fixed thereto, are above the surface 28 of the body of water 30 whereby a tanker 67, being loaded, has its mooring line 68 fastened to the bollard 66. A buoyant loading hose 72 shown extending from the boom 56 to the tanker 67 is slidably connected in the outer end of the loading hose storage leg 62. The repositioning of the boom 56, from the storage position shown in phantom at 56' in FIGURE 1, to the working position as shown in solid lines, is controlled by cable take-up means such as a winch 74, mounted on the deck 47 of the terminal 13 which has a cable 76 connected to the boom 56 outwardly of the pin joints 58 thereof. While the winch 74 is shown schematically as a manual device in FIGURE 1 (and in FIGURE 4), in actuality, the winch 74 would be driven from a power source on the deck 47.

FIGURE 3 shows a partial sectional view of FIGURE 2 illustrating the configuration of the boom 56 which permits the hollow legs 60 and 62 to double as fluid transportation and loading hose storage conduits, respectively. The loading hose 72, contained within the leg 62, has a rigid terminal pipe section 80, affixed to the inner end thereof, adapted to slide in the hollow interior of the leg 62. The inner end of the pipe section 80 is closed off by a blind flange 82, of slightly larger diameter than the pipe section 80, permitting the flange 82 to abut a stop ring 84 fixed within the hollow conduit of the loading hose storage leg 62. The pipe section 80 also has a plurality of fluid entry ports 85 ringed the central portion thereof. The blind flange 82 fits in the hollow conduit of the leg 62 to permit fluid to bypass the blind flange 82 when storing the leg 62 as will be described in detail subsequently. A pair of circumferential expandable pneumatic gripper-seal arrangements 86 are fixed within the hollow conduit of the leg 62, one spaced at either end of the terminal pipe section 80 when the hose 72 is in the extended position shown. Supplying air under pressure to the gripper seals 86 is a rigid pressure line 88, fastened along the leg 62. The line 88 may be connected at its inner end to a flexible line (not shown) extending to the deck 47 of the floating terminal 13 where a compressor (not shown) is located. A retracting cable 90 extends

axially through the hollow leg 62 and is connected at its outer end to a central ear 92 on the inner face of the blind flange 82.

The fluid transportation leg 60 has a drain valve 61 at the inner end thereof, providing selective fluid communication between the interior of said leg 60 and the body of water. For permitting fluid to be transferred from the outer end of the fluid transportation leg 60 to the outer end of the storage leg 62, a port 94 in the outer end of the fluid transportation leg 60 is connected to a similar port 96 in the storage leg 62 by a crossover pipe 98, the fluid transportation leg 60 having a shaped internal wall section 91 for directing the fluid smoothly into the port 94. A valve 100 in the crossover pipe 98 is controlled from the valve actuator 70, shown in FIGURE 1 as being accessible from the upper end of the flotation tank 64. In FIGURE 3 it can be seen that with the hose 72 extended, the fluid entry ports 85 of the pipe section 80 are adjacent the port 96 in the leg 62. Compressed air, when applied to the gripper seals 86, expands them, forming a fluidtight connection between the hose 72 and the section of the conduit of the leg 62 between the gripper seals 86, and furthermore grips the pipe section 80 to prevent it from being retracted during loading. Fluid flows through the crossover pipe 98, if the valve 100 is open, and into the loading hose 72 and outwardly through the hose 72 to a mating connection with the tanker 67 moored to the bollard on the flotation tank 64 of the boom 56 by means of the line 68.

When the tanker 67 approaches the mooring and loading system with the intention of receiving the stored fluid therefrom it is positioned in the most advantageous direction for mooring with respect to the tether pipe 10. The boom 56 is then lowered from the position shown in phantom at 56', in which it is stored, to the partially submerged position illustrated in solid lines, in which it is utilized for transferring the fluids to, and mooring, the tanker 67. A mooring line 68 of the tanker 67 is looped over the bollard 66 on the flotation tank 64 by personnel stationed on the deck of the flotation tank 64. The upper portion of the single point mooring system including the tether arm 22, the floating terminal 13, and the loading boom 56, should be rotated around the tether pipe 10 (by means of the swivel connection 24) into an approximate position in a line between the tanker 67 and upper end of the tether pipe 10. This may be done while the tanker 67 is still operating under its own power by drawing the mooring line 68 taut to bring the floating terminal 13 around. If some motive means, mounted directly on the floating terminal 13 is desirable, propulsion motors (not shown) may be fixed on the floating terminal 13 beneath the surface 28 for positioning the floating terminal 13 into a vertical plane between the tanker 67 and the tether pipe 10. When the tether pipe 10, the terminal 13, and the tanker 67 are substantially lined up, within 20° or 30° for example, the action of the wind and/or ocean currents will tend to bring the floating structures into close alignment and hold the tanker 67 away from the terminal 13 within the limits of the mooring line 68. A second line (not shown) from the tanker 67 would be attached to a blind flange (not shown) on the outer end of the loading hose 72 for withdrawing the loading hose 72 from storage in the leg 62 of the boom 56. The various means for retrieving the outer end of the loading hose 72 in the water, by the tanker 67, are not a part of this invention and will not be specifically described. Such discussions may be found in the Ault U.S. Patent No. 2,701,375, issued Feb. 8, 1955, and the Eiji Suzuki U.S. Patent No. 3,204,658, issued Sept. 7, 1965.

When the present mooring and loading system is to be utilized in conjunction with a subaqueous oil field, a long distance from shore, the fluid to be delivered to the tanker 67 is conducted to the storage and loading facilities by a number of subsea pipelines 102 (one shown),

each connected with a plurality of subsea wellheads by subsea gathering station (not shown). The tether pipe 10 provides fluid communication between the pipeline 102 and the floating terminal 13. For purposes of this illustration, the tether pipe 10 is constructed as a double-walled conduit, forming concentric flow passages, with the subsea pipelines 102 being connected to the annulus of the tether pipe 10, above the universal joint 18, through a flexible section 104. The fluid is forced up the tether pipe 10 and through the swivel 24, which also has concentric passages therethrough. The fluid leaves the swivel 24 through the annulus of a short section of concentric piping 106 and is directed around the pin joint 26 and into a hollow conduit forming a leg 34 of the tether arm 22 by flexible tubing 108. From the leg 34, the fluid travels to the deck 47 of the floating terminal 13 through at least one of the hollow support columns 52 and 54 by way of flexible tubing 109 directing the fluid around the pin joint 46, into the depending pipe section 38, and from there through the hollow buoyant float 42 and the interconnected hollow buoyant support columns. The fluid, delivered to the deck 47 of the floating terminal 13, is processed before being pumped back down into the storage tank 12. If the system is designed for the production of oil, the fluid is directed through separation equipment (not shown) on the deck 47, the oil being separated from any included gas and the pressure being reduced to atmospheric. The resulting gas can then be flared, or, if it is economical, it can be liquefied and stored.

A path for fluid communication is provided from the deck 47 of the floating terminal to a storage area within the storage tank 12. The separated oil is conducted down beneath the sea through the hollow buoyant column 50, a portion of the submerged hollow float 40 (the left-hand end of the float 40 and the hollow buoyant column 48 being blocked by a plate 111 welded across the interior of the float 40), the depending pipe section 36, and the leg 32 of the tether arm 22, bypassing the pin joints 45 and 26 by flexible tubing sections 110 and 112, respectively. The oil is directed through the central passages of the pipe section 106, swivel 24, and the tether pipe 10. The flowing oil bypasses the universal joint 18 by a flexible line 114 connecting the central passage within the tether pipe 10 storage area within the storage tank 12 through the interior of the upstanding stub pipe 15. Since the tank 12 is open on the bottom any suspended solids will settle out, as will included water. It is well within the skill of the art to design pin joints, for use with this system, which can carry the fluid internally. If such joints are used, the flexible tubing, illustrated and described as bridging the joints shown, can be eliminated.

When the processed oil is to be loaded onto a waiting tanker, a three-way, two-position valve 116 in the lower end of the column 50 is positioned to block the flow of oil from the column 50 into the float 40 and instead connects the interior of the hollow float 40 with the interior of the fluid transportation leg 60 of the boom 56 through a section of flexible tubing section 118. The oil then is delivered from the storage tank 12 to the tanker 67 through the central passage of the tether pipe 10 and is directed through the leg 32 of the tether arm 22, the float 40, and the leg 60 of the boom 56. During the loading of the tanker 67 the separation of the oil can continue, the oil being stored in the remaining buoyant columns and the walled-off portion of submerged float 40, as well as any portion of the float 42, not being already used as fluid conduits. All of the support columns 48-54 and the floats 40 and 42, comprising the buoyant structure of the floating terminal 13, can be used for fluid storage if the preprocessed oil from the subsea wells is conducted from the tether arm 22 to the deck 47 through closed conduits, either within the support columns and floats or along the side of the structure, rather than flowing freely through the hollow structure of the terminal 13.

When the loading hose 72 is connected to the tanker 67 and personnel located on the upper end of the flotation tank 64 open the valve 100 through the actuator 70 to permit the oil to flow through the loading hose 72 into the tanker 67, the differential head of the sea water outside and the oil inside the open bottom of the storage tank 12 provides an adequate supply of oil on the suction side of pumps (not shown) mounted in the floating terminal 13 for water depths greater than about 450 feet, the pumps on the terminal 13 providing high pressure for quickly loading the tanker 67. For depths of less than approximately 450 feet, subsurface pumps will be included in the submerged portion of the floating terminal 13. Pumps that may be used for transferring the oil from the bottom storage tank 12 to the terminal 13 are illustrated in more detail in the British Patent No. 1,023,085, published Mar. 16, 1966.

Since the boom 56 is to be raised above the surface 28 of the body of water 30 for the storage thereof, the residual oil should be drained to reduce the handling weight of the boom 56 and therefore reduce the loads thereon. Prior to draining, at the completion of the loading operation, the oil is flushed by pumping water through the boom 56 and the loading hose 72. As the pumped water reaches the loading hose connection at the tanker, the connection is broken and a blind flange is installed on the outer end of the hose 72. The gripper seals 86 are released and the loading hose 72 is then withdrawn into the storage leg 62 of the boom 56 by the line 90 shown running through the interior of the storage conduit in the leg 62. A submersible electric motor and windup reel (not shown) may be mounted in the inner end of the leg 62 or the cable 90 may run up through the boom 56 and one of the buoyant columns, with the windup reel mounted on the deck 47. After the hose 72 is stored, the drain valve 61 is opened, the mooring line 68 is cast off, and the boom 56 is withdrawn up out of the water into the phantom line position shown at 56' by winding up the cable 76 onto the drum of the winch 74. The water in the fluid transportation leg 60 is drained through the open valve 61 at the inner end of the leg 60 while the water in the loading hose storage leg 62 drains out the open inner end of that conduit, the water in the stored loading hose 72 draining out through the fluid entry ports 85 in the pipe section 80, past the loosely fitting terminal flange 82, and out the open inner end of the leg 62. The drainage is made easier by having a one-way valve in the blind flange, attached to the outer end of the loading hose 72, which will permit air to enter the outer end of the leg 62, and the leg 60 through the crossover pipe 98.

A similarly functioning modified structure is shown in FIGURES 4 and 5. The lower portion, beneath the tether arm 22', is identical to that shown in FIGURES 1 through 3. The tether arm 22' is connected to the tether pipe in the same manner as shown in FIGURES 1-3. The other end of the tether arm 22', however, is connected to the floating terminal 13' by means of knee-action pin joints 45' and 46' at approximately the surface 28 of the body of water 30. The boom 56'' is also similar in structure to that of the previous embodiment except that it is also designed to be hinged at the surface 28 of the body of water 30 by pin joints 58'. The boom 56'' is, in this embodiment, not complicated by the oil conduits therethrough having to transport the oil from a point beneath the surface 28 to the inner end of the loading hose 72' above the surface 28. Therefore, the A-frame is in a single plane. The procedure for transporting fluid from the modified structure to a tanker 67 is similar to that described in conjunction with the previously discussed embodiment. The main advantages of the modified unit of FIGURES 4 and 5 reside in the location of the pin joints 45', 46', and 58' at the surface 28 which provides ease of maintenance and reduces the heeling tendency of the floating terminal 13' because the reaction provided by the horizontal component of the forces on the

arm 22' is nearer the same elevation as the horizontal forces imposed by wind and current.

The wind and wave forces acting on the components of the surface unit, in each of the embodiments of the novel single point mooring system herein disclosed, such as the floating terminal 13 (13'), the flotation tank 64 when it is in the loading position, as well as the tanker 67 when moored thereto, will cause the upper portion of the system to be laterally displaced, and in so doing will pivot the tether pipe 10 about the universal joint 18, out of the vertical position shown in FIGURE 1. The movement of the tether pipe 10 away from its vertical position is opposed by the upwardly directed restorative force resulting from the submerged buoyancy tank 19 concentrically fixed to the pipe 10. The magnitude of the restorative force will be determined by the dimensions of the tank 19 and its axial location on the tether pipe 10, the closer to the top of the pipe, the greater the resultant couple acting to right the tether pipe 10.

The single point mooring system of the present invention could serve other functions in conjunction with a subsea production system. Electrical generators, and the prime power source therefor, could be located on the deck 47 of the terminal 13 for supplying necessary power to the pumps and controls of the storage tank 12 and the bottom-mounted satellite gathering system and there-through to the subsea wellheads. The tether pipe 10 would support the interconnecting power lines as well as electrical readout and command lines for the subsea system. These various lines would be supported along the outside of the tether pipe 10, bridging the swivel 24 by flexible lines, if the tether pipe 10 is not allowed to rotate more than one revolution, or rotatable electrical connections may also be formed within the swivel 24.

Although the present invention has been described in conjunction with details of the specific embodiment thereof, it is to be understood that such details are not intended to limit the scope of the invention. The structure, although primarily designed for the transportation of crude oil and/or natural gas from a subsea production system, can obviously serve other functions, such as the transportation of refined hydrocarbons, or tanker fuel, or water, from a storage tank on the bottom or on shore if it is so desired.

What is claimed is:

1. A surface unit of a system for mooring a vessel and loading fluids thereinto from a distant storage facility comprising: a floating terminal, a loading boom pivotably mounted on said floating terminal at the inner end of said loading boom, said loading boom being provided with a flotation tank at the outer end thereof for floating said loading boom substantially horizontally in said body of water, said loading boom including a pair of hollow legs spaced apart at their inner ends, adjacent said floating terminal and converging at their outer ends adjacent said flotation tank forming a portion of the framework of said loading boom; means for conducting fluid from said floating terminal to said outer end of said loading boom including a first of said pair of hollow legs; a buoyant loading hose connected, at its inner end, to said outer end of said loading boom; means for conducting fluid from the outer end of said first hollow leg to said inner end of said loading hose; and means for mooring a vessel to said outer end of said loading boom.

2. A surface unit of a system for mooring a vessel thereto and loading fluids into said vessel, from a distant storage facility, as recited in claim 1 comprising means for sliding said loading hose at least substantially inside of said second hollow leg of said pair of converging legs to store said loading hose when a vessel is not being loaded.

3. A surface unit of a system for mooring a vessel thereto and loading fluids into said vessel, from a distant storage facility, as recited in claim 1 wherein there is a pipe section forming said inner end of said loading hose and slidably adjustable within said second hollow leg for

storing said loading hose in said second hollow leg or extending said loading hose from said second leg; means for selectively sealing and gripping said pipe section in said outer end of said second hollow leg when said loading hose is extended from said second leg; at least one fluid entry port extending through the wall of said pipe section forming said inner end of said loading hose; and a crossover pipe section for connecting the interior of said first hollow leg, at the outer end thereof, with the interior of said second hollow leg, at said outer end thereof, adjacent said at least one fluid entry port with said loading hose extended, whereby fluid can be conducted from said floating terminal, through said first leg of said loading boom and through said loading hose to a vessel moored to said loading boom of said floating terminal.

4. A surface unit of a system for mooring a vessel thereto and loading fluids into said vessel, from a distant storage facility, as recited in claim 2, wherein said floating terminal is located by a substantially vertical tether pipe extending from a fixed point adjacent said marine bottom to near the surface of said body of water; a tether arm forming at least a portion of the connection between said floating terminal and said tether pipe, said tether arm being provided with a pair of hollow legs spaced apart at their inner ends, adjacent said floating terminal and converging at their outer ends adjacent said tether pipe; and means for providing at least two paths of fluid communication between said upper end of said tether pipe and said floating terminal including said hollow legs of said tether arm.

5. A surface unit of a system for mooring a vessel thereto and loading fluids into said vessel, from a distant storage facility, as recited in claim 1 wherein said means for mooring a vessel to said outer end of said loading boom includes at least one bollard on the upper end of said flotation tank above the surface of said body of water.

6. A surface unit of a system for mooring a vessel thereto and loading fluids onto said vessel, from a distant storage facility, as recited in claim 2 including means for storing said loading boom when said boom is not in use, said loading hose being stored in said second hollow leg of said loading boom, comprising cable means fixed at one end to said loading boom outward of the inner end thereof and at a second end to a cable retracting means on said floating terminal whereby said loading boom is stored in a substantially vertical position with at least the major portion thereof being above said surface of said body of water.

7. A surface unit of a system for mooring a vessel thereto and loading fluids onto said vessel, from a distant storage facility, as recited in claim 3 further comprising a valve means for providing selective communications between said interior of said first hollow leg of said loading boom, at the inner end thereof, and said body of water, said inner end of said second hollow leg of said loading boom being open to said body of water, and said pipe section on said inner end of said loading hose loosely fitting in said second hollow leg to permit fluid to flow thereby, through said second hollow leg, when said selective sealing and gripping means is not activated, whereby all fluid may be drained from said pair of hollow legs of said loading boom as said loading boom is pivoted up out of said body of water to be stored.

8. A method for draining said loading boom of claim 7 comprising the following steps:

- (a) pumping water, through the fluid path, of said loading boom, comprising said first hollow leg of said loading boom, said crossover pipe and said loading hose, to flush out the fluid previously loaded on a moored vessel;
- (b) releasing said sealing and gripping means and withdrawing said loading hose into said second leg of said loading boom for storage;
- (c) opening said valve means providing selective com-

munication between the interior of said first hollow leg of said loading boom and said body of water; and (d) withdrawing said loading boom substantially out of said body of water by pivoting said loading boom upward whereby water in first and second hollow legs of said loading boom and in said loading hose stored in said second leg of said loading boom drains out of said open inner end of said second hollow leg and said valve means at the inner end of said first leg as said outer end of said loading boom is lifted out of said body of water.

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TRYGVE M. BLIX, Primary Examiner

U.S. Cl. X.R.

114—0.5, 230; 141—387