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(54) **DYNAMIC POSITIONING CONNECTION**

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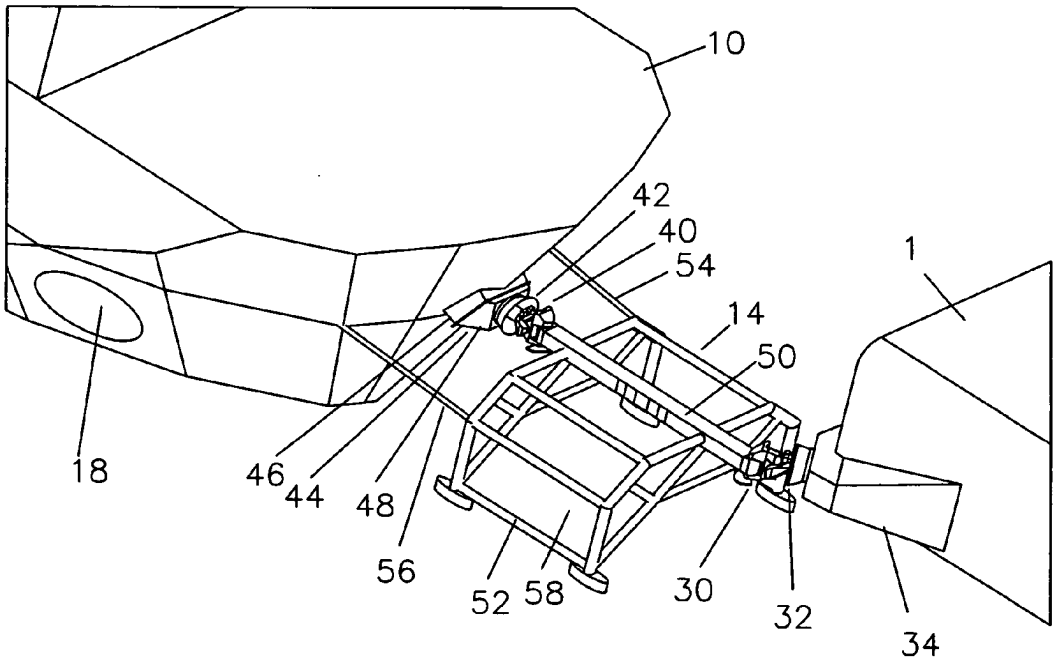
(57) **ABSTRACT**

A method of providing for the dynamic positioning of a vessel comprising providing a dynamically positioned service boat, linking the service boat to the vessel by a rigid link with a first connection between the link and the vessel, a second connection between the link and the service boat, the combination of connections having 3 degrees of rotational freedom, said supply boat having one degree of axial freedom relative to said vessel, and using the power of the service boat to dynamically position said vessel in a desired location.



and service boat **10** to restrict rotational movement in the plane of the surface of the ocean, restricting the two vessels to a single degree of axial freedom relative to each other. When an extra degree of axial freedom is desired, tension can be released on cables or chains **54** and **56**. Buoyancy material **58** is shown generally within the structure **52** to make the structure **52** positively buoyant.

[**0024**] Cables or chains can be installed on the opposite end of the link and attached directly to the vessel to restrict the degree of motion on the opposite end of the link.

[**0025**] Referring now to **FIG. 3**, pivoting joint **30** is shown in greater detail. Central member **60** is pivoted horizontally relative to main axial member **50** about a vertical pin generally located at **62** (not shown). Motor **63** can be powered to rotate central member **60** about the vertical pin located at **62**. Stab **64** is pivoted vertically relative to central member **60** about a horizontal pin generally located at **66** (not shown). Stab **64** lockingly engages funnel **32** to connect to vessel **1** and can rotate about the centerline of the stab. Cylinder **68** can be used to position the stab **64** when the stabbing connection is made. Vertical pin at **62**, horizontal pin at **66**, and stab **64** provide **3** degrees of angular freedom.

[**0026**] Referring now to **FIG. 4**, pivoting joint **40** is shown in greater detail. Central member **70** is pivoted horizontally relative to main axial member **50** about a vertical pin generally located at **72** (not shown). Motor **73** can be powered to rotate central member **70** about the vertical pin located at **72**. Stab **74** is pivoted vertically relative to central member **70** about a horizontal pin generally located at **76** (not shown). Stab **74** lockingly engages funnel **42** to connect to service boat **10** and can rotate about the centerline of the stab. Cylinder **78** can be used to position the stab **74** when the stabbing connection is made. Horizontal pin at **66** vertical pin at **76**, and stab **74** provide decrees of angular freedom.

[**0027**] The particular embodiments disclosed above are illustrative only, as the invention may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the invention. Accordingly, the protection sought herein is as set forth in the claims below.

1. A method of providing for the dynamic positioning of a vessel comprising

providing a dynamically positioned service boat,

providing a link,

providing a first connection between said link and said vessel,

providing a second connection between said link and said service boat,

providing three degrees of rotational freedom by the combination of said first connection and said second connection,

providing one degree of axial freedom between said service boat and said vessel by the combination of said first connection and said second connection, and using the power of said service boat to position said vessel in a desired location.

2. The method of claim 1, further comprising said combination of said first connection and said second connection providing a second degree of axial freedom.

3. The method of claim 1, further comprising providing flotation material for said link such that said link is positively buoyant.

4. The method of claim 1 further comprising providing sideways thrust on said service boat to provide a lateral force on said link and thereby a lateral force on said vessel.

5. The method of claim 4 further comprising the combination of said lateral forces and axial forces from said service boat onto said link allows said link to exert forces on said vessel in any horizontal direction.

6. The method of claim 1 further comprising said first connection being a stab engaging a funnel.

7. The method of claim 6 further providing a cylinder to position said stab prior to entering said funnel.

8. The method of claim 1 further comprising that said first connection being magnetically attached to said vessel.

9. The method of claim 1 further comprising said second connection having a portion permanently affixed to said service boat and a portion removeably attached to said permanently affixed portion on said service boat.

10. The method of claim 9 further comprising said removeably attached portion being a funnel.

11. A method of providing for the dynamic positioning of a vessel comprising

providing a dynamically positioned service boat,

providing a rigid link,

providing a first connection between said link and said vessel, said first connection

providing 3 degrees of rotational freedom and one degree of axial freedom,

providing a second connection between said link and said service boat, said second connection providing 3 degrees of rotational freedom and 2 degrees of axial freedom, and using the power of said service boat to position said vessel in a desired location.

12. A method of providing for the dynamic positioning of a vessel comprising

providing a dynamically positioned service boat,

providing a link capable of pushing or pulling,

providing a first connection between said link and said vessel, said first connection providing 3 degrees of rotational freedom,

providing a second connection between said link and said service boat, said second connection providing three degrees of rotational freedom,

providing one degree of axial freedom between said vessel and said service boat,

and using the power of said service boat to position said vessel in a desired location.

DYNAMIC POSITIONING CONNECTION

BACKGROUND OF THE INVENTION

[0001] In shallow waters, pipelay is primarily done by an "S-Lay" method, which means that the welding is done along the deck of a flat barge and then the pipe bends down to the ocean floor in a sort of "S" curve. The pipe bends down on a radiused stinger and then naturally curves back to horizontal as it reaches the ocean floor. In deeper water, the forces on the stinger and the size of the required stinger make it more favorable to weld the pipe together in a near vertical position and have a single bend at the ocean floor. The forms a "J" in the pipe and gives it the name of the "J-Lay" method.

[0002] Offshore deepwater pipeline laying systems are characteristically limited to high cost specialty vessels due the combination of loads and positioning required to accomplish the pipelaying. J-Lay pipelay systems are characteristically complicated and require special connections to the vessel. This makes a costly specialty custom vessel an appropriate investment. As the custom vessel is an appropriate investment, investment in onboard dynamic positioning also becomes an appropriate investment.

[0003] Dynamic positioning is using the propellers to actively hold the vessel in position, in contrast to passively holding the vessel in position with anchors and anchor lines.

[0004] A pipelay system such as the Flex J-lay Tower described in U.S. Pat. No. 6,776,560 provides the unique ability to be simply mounted on a flat and economical barge. Such a barge or vessel would typically not have dynamic positioning available. The barge or vessel could then be positioned along the pipeline route by one or more service boats which can provide the dynamic positioning capability. The service boats would be connected to the barge or vessel by the connections of this invention.

[0005] Such service boats have previously been connected to vessels of this type by a rope, which provides only an axial tension. If the service boat wants to provide a force on the vessel in any direction other than straight along the rope, the service boat must move radially around the connection point on the vessel to another position. The service boat could then pull in that direction only.

[0006] An appropriate mechanical connection would have the ability for the service boat to push or pull the vessel. When the service boat has a horizontal bow thruster, it can provide a sideways force on the connection, and therefore on the vessel. By combinations of axial thrust and sideways bow thrusters, the service boat can impart a force on the vessel in any horizontal direction.

[0007] A complication to a mechanical connection between the vessel and the service boat is that the larger vessel and the smaller supply boat will characteristically have different periods of vertical motion. As one is going up, the other will be going down at some times during operations.

BRIEF SUMMARY OF THE INVENTION

[0008] The object of this invention is to provide a system for improved dynamically positioning a vessel by mechanically connecting one or more dynamically positioned service boats to the vessel.

[0009] A second object of the present invention is to provide 3 degrees of rotational freedom on the mechanical connection between the vessel and the one or more service boats.

[0010] A third object of the present invention is to provide one degree of axial freedom for normal operations.

[0011] Another object of the present invention is to provide a second degree of mechanical freedom when desired.

[0012] Another object of the present invention is to allow the service boat to exert a sideways force on the vessel.

[0013] Another object of this invention is to allow the service boat to exert a push or pull on the vessel in any direction

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

[0014] **FIG. 1** is a view of a j-lay system on a barge and of a supporting pipe barge, each having service boats connected by connections of this invention for dynamic positioning.

[0015] **FIG. 2** is a view of a portion of the pipelay barge and a service boat with the connection of this invention between.

[0016] **FIG. 3** is an enlarged view of the joint between the central connection member and the pipelay barge.

[0017] **FIG. 4** is an enlarged view of the joint between the central connection member and the service boat with dynamic positioning.

DETAILED DESCRIPTION OF THE INVENTION

[0018] **FIG. 1** shows a pipelay vessel **1** with a j-lay tower **2** mounted on the deck **4**. A pipe supporting mechanism **6** is shown with a portion of the pipeline **8** suspended in the ocean water. Service boats **10** and **12** are attached to the pipelay vessel **1** by links **14** and **16** respectively.

[0019] Side thrusters **18** are provided near the bow of the service boats **10** and **12** which enable the service boats to provide a lateral force on links **14** and **16**. Various combinations of lateral and axial forces from the service boat to the vessel allow the service boat to impart forces in any direction to the vessel.

[0020] An additional barge **20** is shown in a position to re-supply the pipelay vessel **1** with pipe or other supplies. A third service boat **22** is shown attached by link **24**.

[0021] Referring now to **FIG. 2**, link **14** is shown between vessel **1** and service boat **10**. Pivoting joint **30** is shown engaging funnel **32** which is mounted to vessel **1** at **34**. The mounting can be prepared and permanently affixed to the vessel **1**, can be removeably attached, or can be magnetically attached.

[0022] Pivoting joint **40** is shown engaging funnel **42** which is mounted to service boat **10** at **44**. Portion **46** of the mounting can be prepared and permanently affixed to the vessel **10** and portion **48** can be bolted to portion **46**.

[0023] Link **14** has a main axial member **50** and a structure **52**. Cables or chains **54** and **56** connect between structure **52**

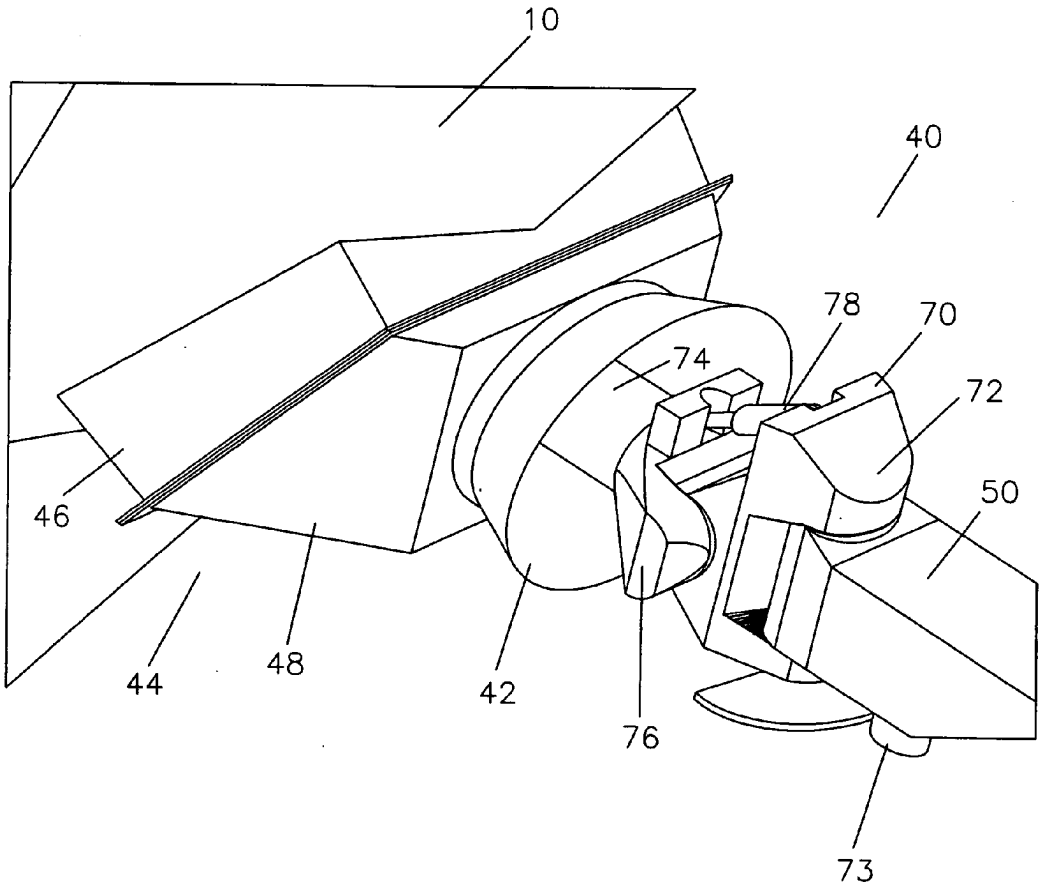


FIGURE 4

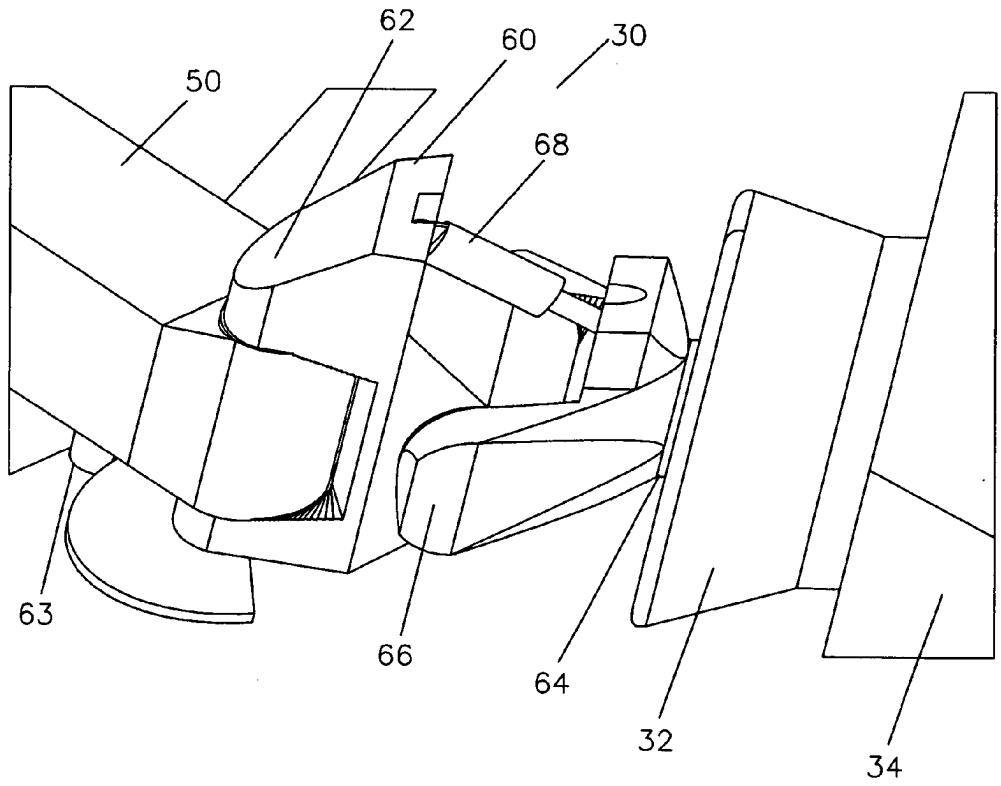


FIGURE 3

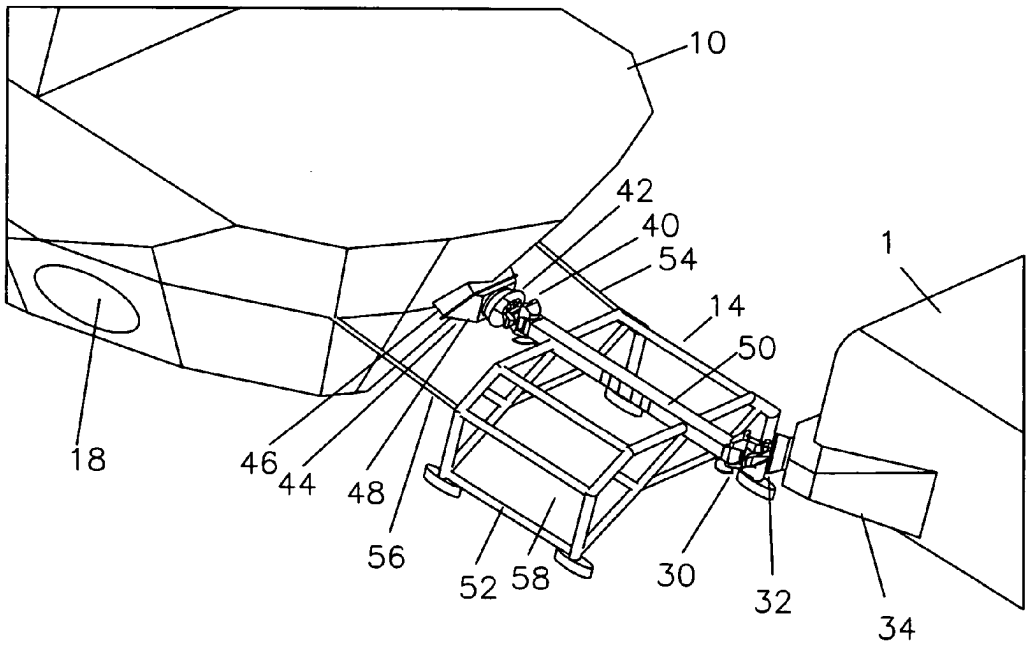


FIGURE 2

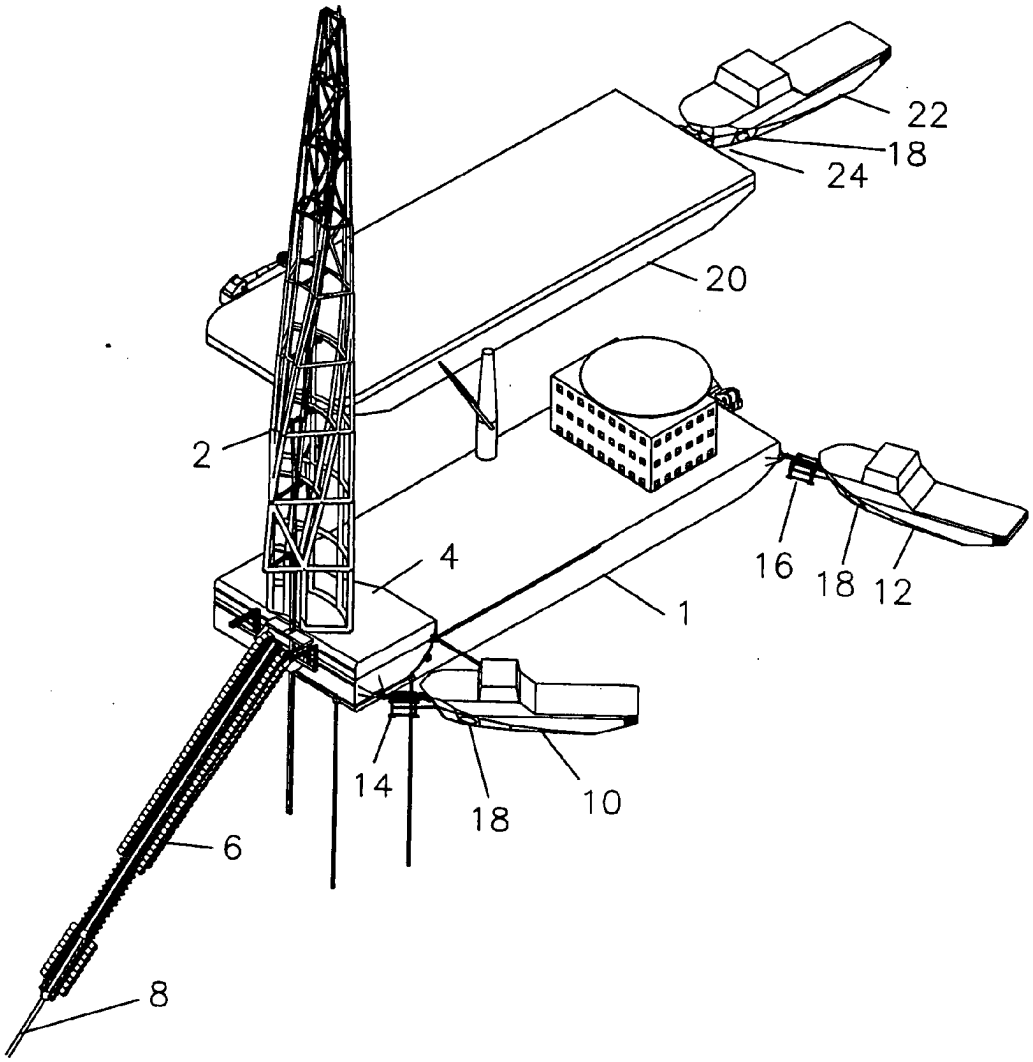


FIGURE 1

13. The method of claim 12, further comprising said second connection provides a third degree of angular freedom

14. The method of claim 12 further comprising providing a second degree of axial freedom between said vessel and said service boat.

15. The method of claim 12 further comprising providing sideways thrust on said service boat to provide a lateral force on said link and thereby a lateral force on said vessel.

16. The method of claim 15 further comprising the combination of said lateral forces and axial forces from said service boat onto said link allows said link to exert forces on said vessel in any horizontal direction.

17. The method of claim 12 further comprising said first connection being a stab engaging a funnel.

18. The method of claim 17 further providing a cylinder to position said stab prior to entering said funnel.

19. The method of claim 12 further comprising that said first connection being magnetically attached to said vessel.

20. The method of claim 12 further comprising said second connection having a portion permanently affixed to said service boat and a portion removeably attached to said permanently affixed portion on said service boat.

21. The method of claim 20 further comprising said removeably attached portion being a funnel.

22. The method of claim 12, further comprising providing flotation material for said link such that said link is positively buoyant.

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