Nov. 5, 1968 N. E. JAMESON 3,409,047

FLUID TRANSFERRING APPARATUS

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FIG_1

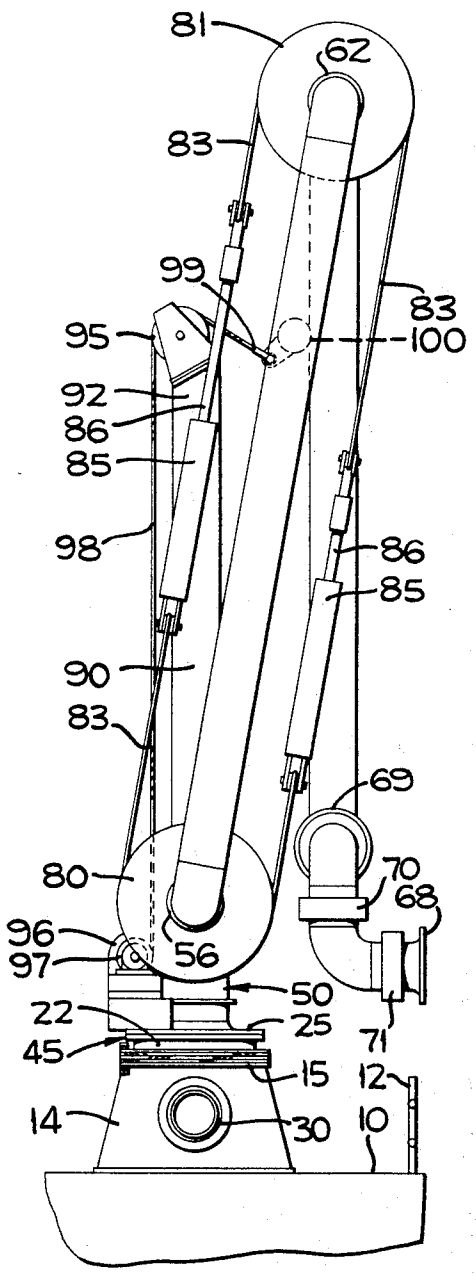

FIG_2

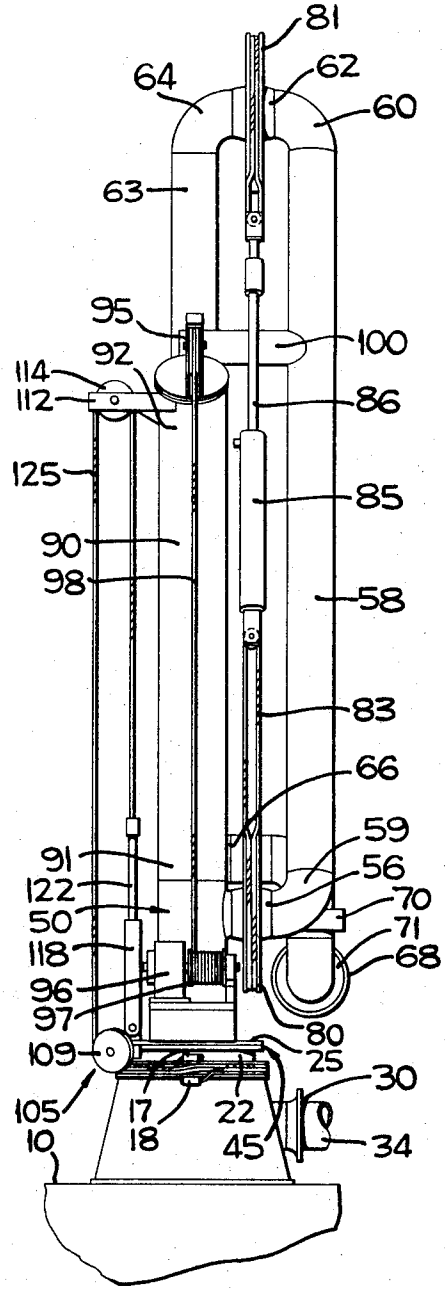

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FIG_3

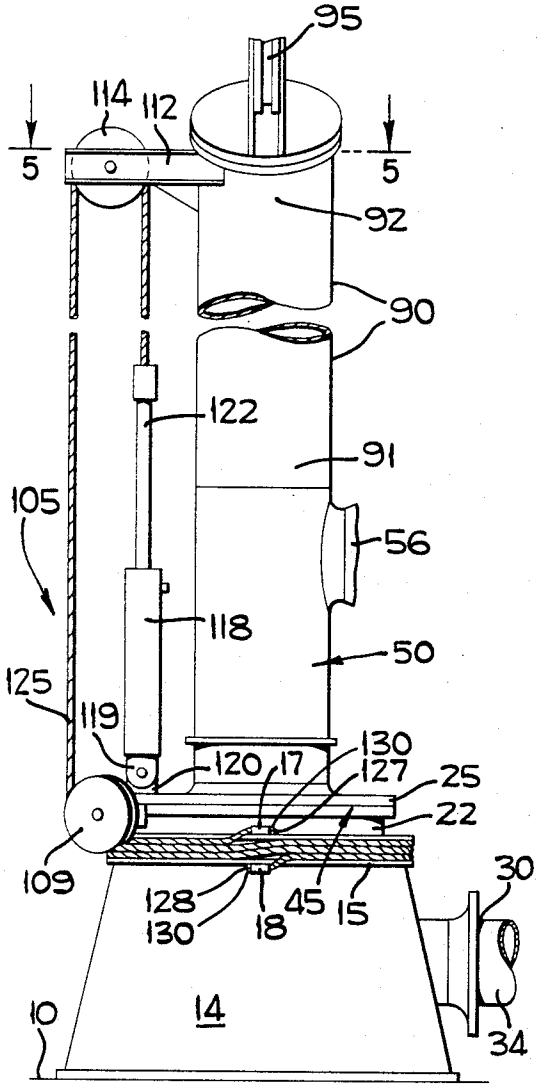
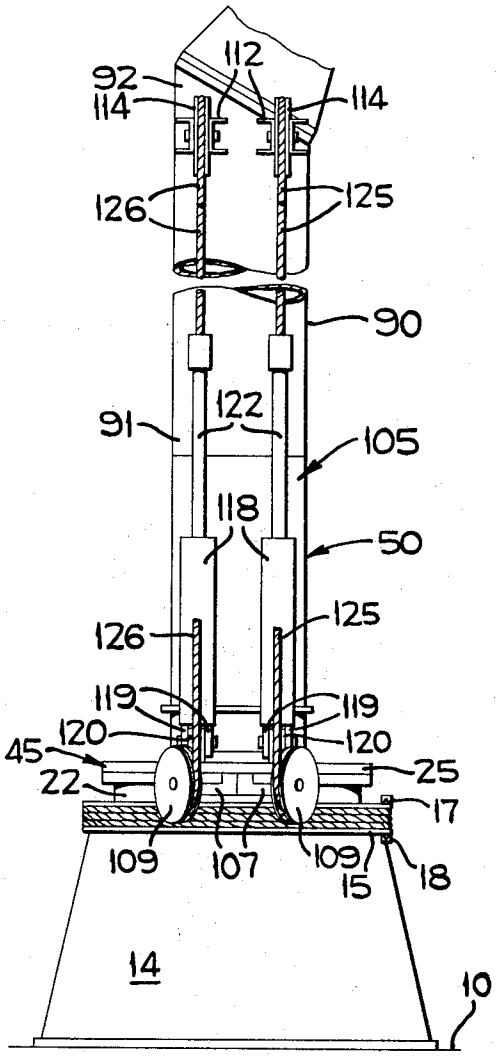


FIG_4



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FLUID TRANSFERRING APPARATUS

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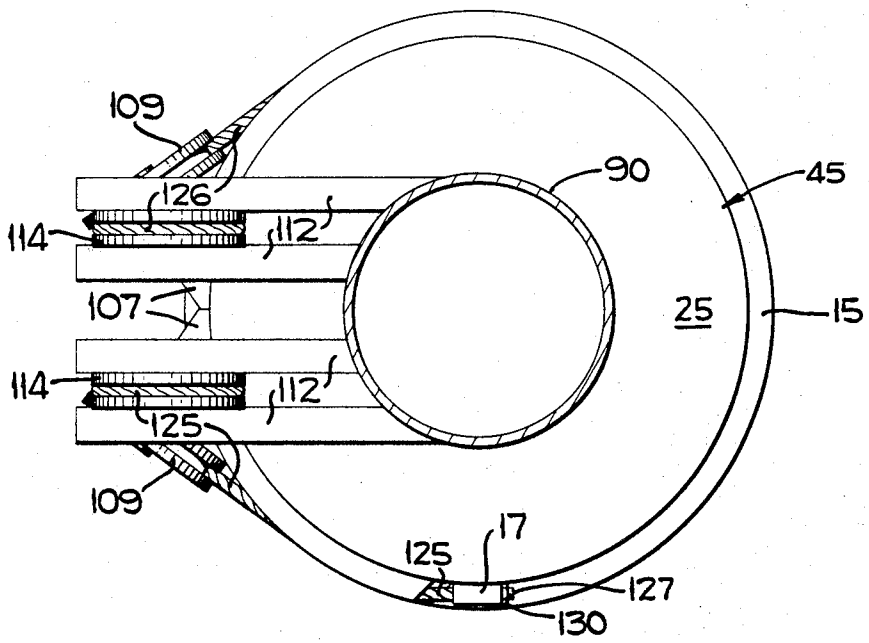
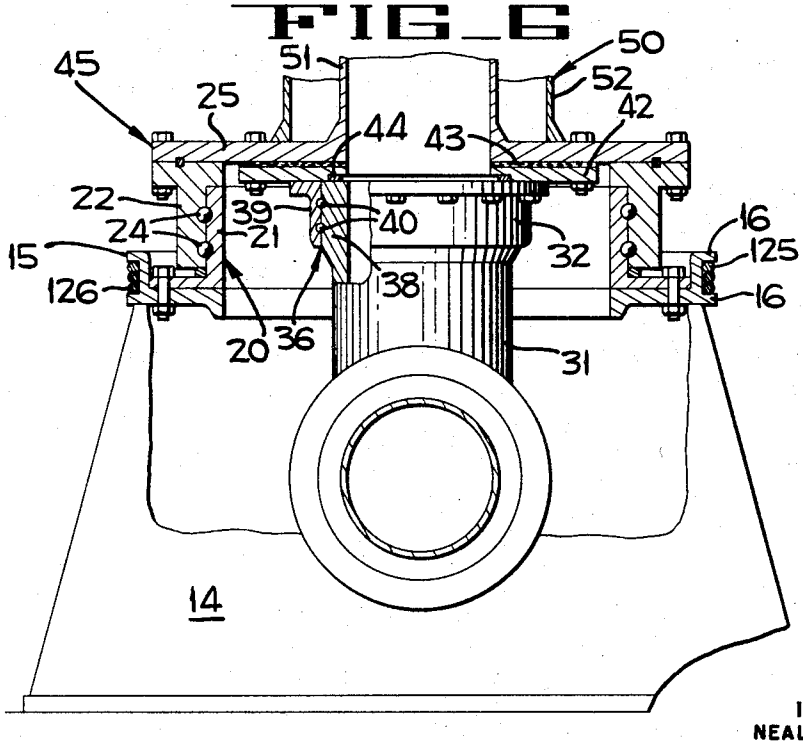


FIG_5

FIG_6



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FLUID TRANSFERRING APPARATUS

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5 Claims. (137—615)

ABSTRACT OF THE DISCLOSURE

A fluid transferring apparatus including a turntable rotatably mounted on a base, an upstanding riser conduit mounted on the turntable and an arm-like conduit pivotally connected to the riser, a mast on the turntable, a system of sheaves and cables associated with the base, turntable, and mast to rotate the turntable on the base, and another sheave and cable system associated with the turntable, mast, and arm-like conduit to pivot this conduit on the riser.

The present invention pertains to fluid transferring apparatus and, more particularly, to such an apparatus which is movable by mechanical power about vertical and horizontal axes and which can operate in a minimum of space.

The fluid transferring apparatus of the present invention is especially adapted to be mounted on board ship. In this manner, the ship can deliver or receive fluid cargo at piers where, for economic or other reasons, there is no pier-mounted marine arm. There are several problems involved in mounting a marine loading arm on board a ship. The arm must be of minimum surface area and height in order to minimize the effect of wind action against the arm, and the arm must occupy, and be able to operate within, a minimum of horizontal deck space.

Accordingly, it is an object of the present invention to provide an improved fluid transferring apparatus.

Another object is to provide a fluid transferring apparatus which is movable by mechanical power about vertical and horizontal axes and which can operate in a minimum of space.

Another object is to provide a fluid transferring apparatus especially adapted to be mounted on board a ship.

Another object is to provide a ship mounted marine arm which has a compact horizontal slewing mechanism capable of slewing the arm whether the deck of the ship is horizontal or inclined.

These, together with other objects, will become apparent upon reference to the following description and accompanying drawings, in which:

FIGURE 1 is a side elevation of a fluid transferring apparatus mounted on board a ship and embodying the principles of the present invention.

FIGURE 2 is a rear elevation of the apparatus shown in FIGURE 1.

FIGURE 3 is an enlarged rear elevation of a portion of the apparatus of FIGURE 1, with parts being broken away, and particularly illustrating the horizontal slewing mechanism of the present invention.

FIGURE 4 is a fragmentary side elevation of the apparatus shown in FIGURE 3 and with parts being broken away.

FIGURE 5 is an enlarged section taken on a plane indicated by line 5—5 in FIGURE 3.

FIGURE 6 is an enlarged view, partially in side elevation and partially in section, of the apparatus shown in FIGURE 1.

With reference to FIGURES 1 and 2, a deck of a ship is generally indicated by the numeral **10**, and railing **12**

projects upward from the deck. The fluid transferring apparatus embodying the present invention includes a hollow frusto-conical base **14** secured to the deck and spaced inward of the railing. As best shown in FIGURE 6, a circular rim **15**, having a U-shaped cross-section, is rigidly secured to the upper end of the base in concentric relation therewith. This rim has spaced upper and lower flanges **16** defining a channel therebetween, and upper and lower sleeves **17** and **18** are respectively secured to these flanges, outside of the channel, and on the same side of the base, as shown in FIGURES 3 and 4.

An outside swivel joint **20** (FIG. 6) includes a male portion **21** having a horizontal flange bolted to the rim **15** and an upstanding flange projecting into a female portion **22**. The female portion rotates relative to the male portion and is facilitated in this rotation by balls **24** removably received in grooves between the male and female portion. An annular outer mounting plate **25** is bolted to the female portion of the swivel joint and is located in a substantially horizontal plane.

A transfer conduit **30** includes an elbow **31** projecting into the base **14** and having an inner, upwardly disposed end **32** closely spaced below the outer mounting plate **25**. This transfer conduit has an outer end portion **34** adapted for connection to the hold or other fluid receptacle, not shown, on board the ship. An inside swivel joint **36** includes a male portion **38** formed as a portion of the inner end **32** of the transfer conduit, a female portion **39** circumscribing the male portion, and balls **40** removably received in grooves in the male and female portions so as to mount the female portion for rotation relative to the male portion. An inner mounting plate **42** is secured both to the female portion of the inner swivel joint and to the outer mounting plate. A gasket or static seal **43** is interposed the inner and outer mounting plates, and a dynamic seal **44** is located between the male portion **38** and the plate **42**. The female portions **22** and **39** and the outer and inner mounting plates **25** and **42** constitute a turntable **45**.

The inner and outer mounting plates **42** and **25** have openings communicating with the elbow **31** and with a riser conduit **50** integrally projecting upward from the outer mounting plate. This riser conduit includes an inner fluid conducting pipe **51** in direct communication with the elbow **31** and an outer steam jacket **52** in spaced circumscribing relation to the inner pipe. It is to be understood that the fluid transferring apparatus shown and described herein may be used for conducting hot or cold fluids and thus may be provided with the necessary insulation, such as the steam jacket **52** affords.

From the foregoing, and with particular reference to FIGURE 6, it is important to note that the riser conduit **50** is mounted on the base **14** for rotation about a vertical axis, this being the longitudinal axis of the riser conduit.

Although well known in the art, the subject fluid transferring apparatus also includes an inner swivel joint **56** (FIG. 2) connected to one side of the riser conduit **50**, an inner conduit **58** having an inner elbow **59** connected to the swivel joint **56** and an outer elbow **60** connected to an outer swivel joint **62**, an outer conduit **63** having an inner elbow **64** connected to the swivel joint **62** and an outer elbow **66** connected to an outboard coupling **68** (FIG. 1) by swivel joints **69**, **70** and **71**. Thus, fluid communication is effected between the outboard coupling and the transfer conduit **30** through the riser conduit **50**, the inner conduit **58**, and the outer conduit **63**. Furthermore, the inner conduit is mounted on the riser conduit, by the swivel joint **56**, for pivotal movement about an axis perpendicular to the axis of the riser conduit; normally, the inner conduit pivots relative to the riser conduit about a horizontal axis, but such axis

moves out of horizontal when the deck **10** tilts under wave action. Also, the outer conduit pivots relative to the inner conduit about an outer axis parallel to said inner axis.

To enable powered movement of the outer conduit **63** about said outer axis, an inner pulley **80** is concentrically mounted (FIGS. 1 and 2) on the inner swivel joint **56** and is fixed against rotation, and an outer pulley **81** is secured to that portion of the outer swivel joint **62** which is rigid with the outer conduit **63**; thus, the inner pulley is fixed relative to the riser conduit **50**, whereas the outer pulley rotates with the outer conduit relative to the inner conduit. Furthermore, the outer pulley is concentric with the outer axis and coplanar with the inner pulley. A cable **83** is trained around the inner and outer pulleys and fastened thereto, and outer-conduit control cylinders **85** are connected in this cable on opposite sides of the inner conduit. Piston rods **86** project outward from the cylinders and are also connected to the cable. Thus, by retracting one of the piston rods, and allowing the other to extend, the outer conduit is pivoted in either a clockwise or a counterclockwise direction about the outer axis. The mechanism described in this paragraph for controlling the movement of the outer conduit is disclosed and claimed in the copending application of Bily, Ser. No. 171,841, assigned to the assignee of the present application, and thus forms no part of the present invention.

Insofar as the present invention is concerned, however, it is important to note that a mast **90** (FIGS. 1–4) has a lower end **91** rigidly secured to the upper end of the riser conduit **50** and an upper end **92**. A grooved upper wheel **95** is mounted on the upper end of the mast for rotation about an axis parallel to said inner axis of the inner conduit **58**. A powered elevational control winch **96** (FIGS. 1 and 2), incorporating a brake not shown, is rigidly secured to the outer mounting plate **25** and includes a drum **97** located directly below the upper wheel and having its axis parallel with the axis of the wheel. The winch includes a cable **98** wound around the drum and trained over the upper wheel. The cable has an outer end **99** connected to a bracket **100** which is rigidly secured to the inner conduit **58** relatively adjacent to the outer elbow **60**. Thus, operation of the winch raises and lowers the inner conduit about its inner axis. Furthermore, because of their mounting, the mast and the winch are rotatable with the riser conduit, the inner conduit and the outer conduit, about the vertical axis of the riser conduit.

A significant feature of the present invention is a mechanism **105** for rotating, that is slewing, the apparatus about the axis of the riser conduit **50**. This mechanism includes a pair of lower brackets **107** (FIGS. 4 and 5) rigidly secured to the female portion **22** of the outside swivel joint **20** and projecting outward therefrom beyond the rim **15**. Left and right lower sheaves **109** (FIG. 4) are individually rotatably mounted on these brackets **107** in generally tangential relation to the rim (FIG. 5) and in acute angular relation to each other. Upper brackets **112** project outward from the upper end **92** of the mast **90** in parallel relation to each other and individually above the lower sheaves. Left and right upper sheaves **114** are rotatably mounted in the upper brackets on a common axis and are likewise individually spaced above and in acute angular relation to the lower sheaves.

Slewing cylinders **118** (FIGS 3 and 4) have spaced ears **119** pinned to lugs **120** rigid with and projecting upward from the outer mounting plate **25** adjacent to the lower sheaves **109**. Piston rods **122** extend upward from the cylinders and are connected to cables **125** and **126**. The cables are individually trained over the upper sheaves and extend downward around the lower sheaves. The cable **125** passes from its lower sheaves entirely around the rim **15**, in the channel thereof, and has an end **127** extended through the upper sleeve **17**. The other cable **126** passes from its lower sheave entirely around the rim in the opposite direction from the cable **125**, and has an end **128** extended through the lower sleeve **18**. Fasteners **130** are removably connected to the ends of the cables for preventing their removal from the sleeves.

In operation, when it is desired to raise and lower the inner and outer conduits **58** and **63**, the winch **96** is operated to pay out or in the cable **98**. Furthermore, when it is desired to pivot the outer conduit relative to the inner conduit, the conduit control cylinders **85** are actuated. By the winch and cylinders **85**, the conduits are movable into and out of a stowed position as shown in FIGS. 1 and 2. To illustrate how compact the subject apparatus is in its stowed position, certain dimensions of an actual embodiment are given at this point, it being understood that the invention is not limited to these dimensions. In said actual ambodiment, the distance from the deck **10** to the rim **15** is three feet and from the deck to the highest point of the apparatus is thirty-three feet; also the maximum horizontal dimension of the apparatus in the stowed position is twelve feet; and the conduits in said apparatus are fourteen and sixteen inches in diameter.

When it is desired to slew the riser, inner, and outer conduits **50**, **58** and **63**, the slewing cylinders **118** are operated. When the riser conduit is to be moved in a clock-wise direction as viewed in FIGURE 5, the piston rod **122** for the left slewing cylinder **118** (FIG. 4) is drawn into its cylinder and the piston rod for the right slewing cylinder is allowed to extend further out of its cylinder (as by bleeding fluid from the right slewing cylinder). In this manner, the cable **126** is tensioned to place a torque on the left lower sheave **109**; this torque is imparted to the turntable **45** causing it to rotate in a clockwise direction. Conversely, if it is desired to rotate the turntable in a counterclockwise direction, the right piston rod is drawn into its cylinder and the left piston rod is allowed to extend. It should be noted that, even if the deck **10** of the ship is inclined, as it often will be, the cylinders are still capable of slewing the turntable.

The mounting of the elevational control winch **96**, the lower sheaves **109**, and the slewing cylinders **118** on the turntable **45**, as well as the mounting of the mast **90** on the riser conduit **50** results in a very compact structure. The winch-control of elevation movement of the inner and outer conduits **58** and **63** avoids the use of any counterweights on arms projecting from the inner conduit; as a result, the total height of the apparatus is minimized and the amount of horizontal space required when the inner conduit is in its projecting positions is also minimzed. Havng the slewing cylnders disposed upright rather than horizontal also minimizes the horizontal dimension of the apparatus.

Also, theturntable **45**, the base **14**, and the rim **15** cooperate to facilitate the slewing action whether the deck **10** of the ship is horizontal or inclined.

Although a preferred embodiment of the present invention has been shown and described, it will be understood the various changes and modifications may be made in the details thereof without departing from the spirit and the scope of the appended claims.

Having described the invention, what is desired to be secured by Letters Patent is as follows:

1. In a fluid transferring apparatus including a riser conduit, an inner conduit pivoted to the riser conduit for elevational movement, and means for pivoting the inner conduit relative to the riser conduit, the combination of a base; a turntable rotatably mounted on the base, said riser conduit being secured to the turntable and projecting upward from the base; a mast mounted on and projecting upward from the riser conduit; means in the base for conducting fluid to or from the riser conduit; and means for rotating the turntable including a rim secured to the

base in circumscribing relation to the axis of rotation of the turntable, a lower sheave mounted on said turntable, an upper sheave mounted on said mast, a cable trained around said sheaves and rim and having opposite ends, means connecting one end of the cable to the rim, and means interconnecting the other end of the cable and said turntable for tensioning said cable.

2. The apparatus of claim 1 wherein said fluid conducting means includes a transfer conduit projecting into said base and wherein said turntable includes swivel joint means interconnecting said transfer conduit and riser conduit.

3. In a fluid transferring apparatus including a riser conduit, an inner conduit pivoted to the riser conduit for elevational movement, and means for pivoting the inner conduit relative to the riser conduit, the combination of a base; a turntable rotatably mounted on the base, said riser conduit being secured to the turntable and projecting upward from the base; a mast mounted on and projecting upward from the riser conduit; means in the base for conducting fluid to or from the riser conduit; and means mounted on the turntable, associated with the mast, and connected to the base for rotating the turntable relative to the base while maintaining fluid communication between said riser conduit and said fluid conducting means in the base, said rotating means including a rim secured to the base in circumscribing relation to the axis of rotation of the turntable, spaced lower sheaves mounted on said turntable generally tangentially of said rim, spaced upper sheaves mounted on said mast and individually located above said lower sheaves, cables individually trained around corresponding upper and lower

sheaves and wound in opposite directions around said rim, said cables having lower ends adjacent to said rim and upper ends adjacent to said mast, means connecting the lower ends of the cables to said rim, and fluid actuated means interconnecting the upper ends of the cables and said turntable for tensioning said cables to rotate the mast, riser conduit and inner conduit in opposite directions relative to said base.

4. The apparatus of claim 1 including an outer conduit pivoted to the inner sonduit, means for pivoting the outer conduit relative to the inner conduit, said means for pivoting the inner conduit being capable of moving the inner conduit into a stowed position projecting upward in nearly parallel relation to the mast, and said means for pivoting the outer conduit being capable of moving the outer conduit into a stowed position dependent from the inner conduit and substantially parallel to the mast.

5. The apparatus of claim 1 including a vehicle having a deck movable between horizontal and inclined positions, said base being rigidly secured to the deck, and said rotating means being capable of rotating the turntable when the deck is horizontal and inclined.

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