

[54] **METHOD AND APPARATUS FOR TRANSPORTING AND LAUNCHING AN OFFSHORE TOWER**[75] Inventors: **Albert M. Koehler; Jesse W. Crout; Larry K. Shaw**, all of Houston, Tex.[73] Assignee: **Brown & Root, Inc.**, Houston, Tex.[22] Filed: **Apr. 25, 1973**[21] Appl. No.: **354,470****Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 336,276, Feb. 27, 1973.

[52] U.S. Cl. **61/46.5, 114/5 D, 114/43.5, 114/5 D**[51] Int. Cl. **E02b 17/00, B63c 13/00**[58] Field of Search **61/46.5, 65; 114/5 F, 114/43.5**[56] **References Cited****UNITED STATES PATENTS**

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Primary Examiner—Jacob Shapiro*Attorney, Agent, or Firm*—Burns, Doane, Swecker & Mathis[57] **ABSTRACT**

A method and apparatus for transporting and launching an offshore tower. The apparatus comprises a watertight buoyancy system for supporting an offshore tower in a generally horizontal transporting posture substantially above the surface of a body of water and subsequently for controllably righting the offshore tower onto the bed of the body of water at a preselected marine site.

One specific embodiment of the transport and launch apparatus includes a first and second tubular

buoyancy member, each of which is releasably connected to at least one leg of an offshore tower. The first and second tubular buoyancy members are transversely interconnected along the lengths thereof to operably unify the members together. First and second auxiliary tubular buoyancy members are connected to the outboard sides of the first and second tubular buoyancy members respectively for augmenting the buoyancy and stability of the transport and launch apparatus. First and second spherical buoyancy chambers are connected to a base portion of the offshore tower in positions substantially opposed to base portions of the first and second tubular buoyancy members. Means are connected to the first and second tubular buoyancy members, the first and second auxiliary tubular buoyancy members, and the first and second spherical chambers for operably controlling the buoyancy thereof whereby an offshore tower may be transported to a marine site in a generally horizontal posture and controllably launched at the preselected marine site into a generally vertical posture onto the bed of the body of water.

The method of transporting and launching an offshore tower according to the invention comprises the steps of floating an offshore tower to a preselected marine site upon a buoyancy assembly including tubular and spherical buoyancy chambers. After reaching the preselected offshore site, at least a portion of the tubular buoyancy chambers at the base of the offshore tower are ballasted and thereby pitching the offshore tower about first and second auxiliary tubular buoyancy members until first and second spherical buoyancy chambers engage the surface of the body of water. The method further includes ballasting the first and second spherical buoyancy chambers to right the offshore tower within the body of water and further ballasting the spherical and tubular buoyancy members to lower the righted offshore tower onto the water bed. The final step entails removing at least the tubular buoyancy members from the offshore tower for subsequent reuse.

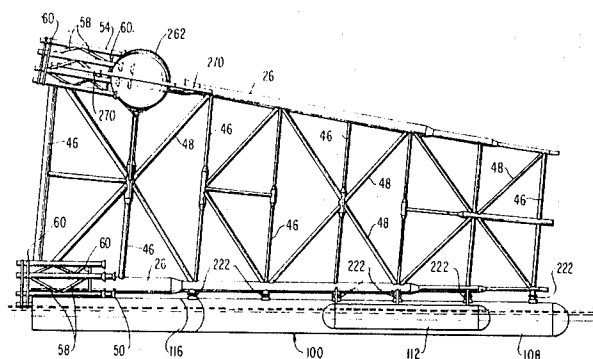
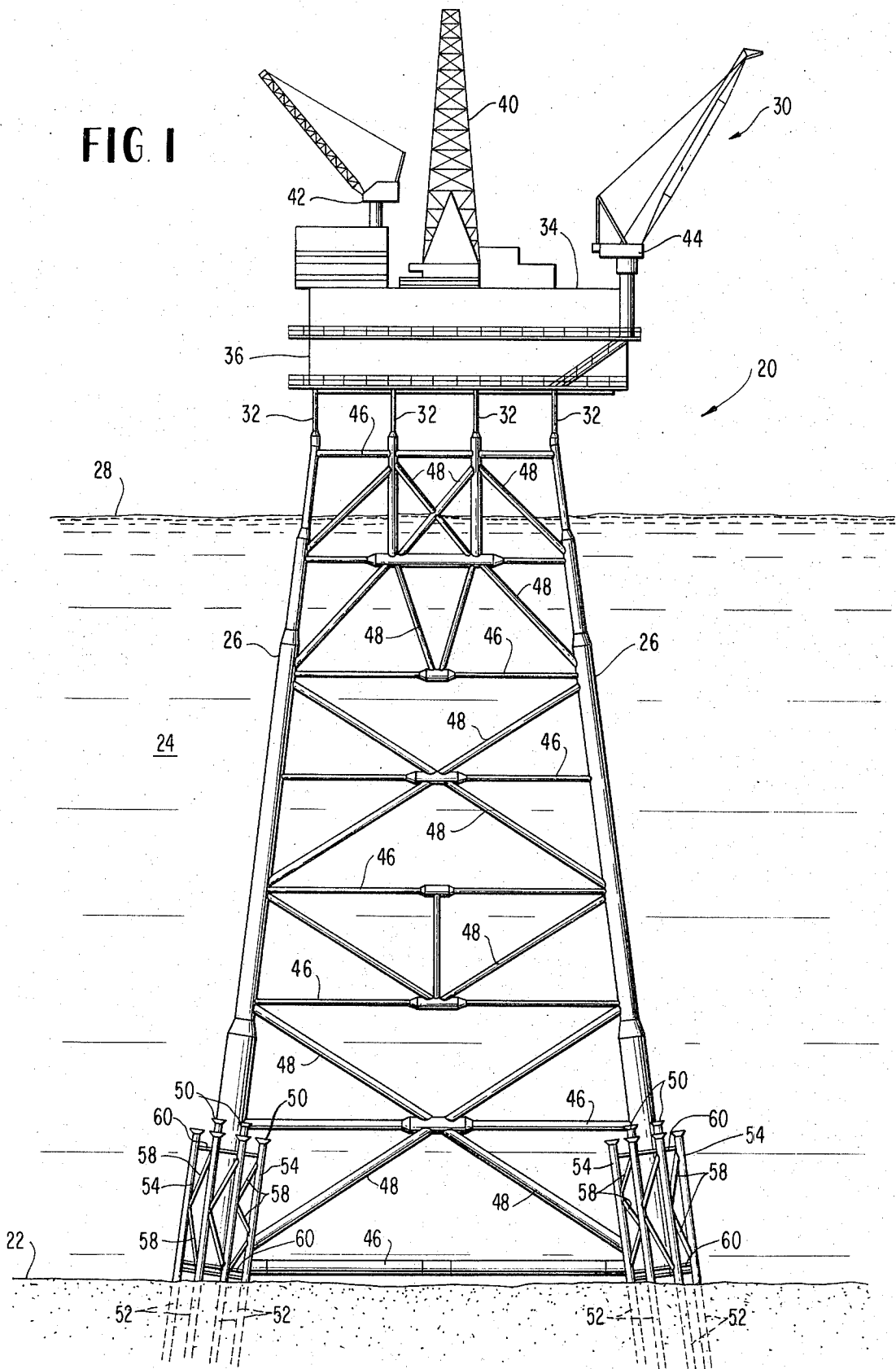
27 Claims, 30 Drawing Figures

FIG. 1



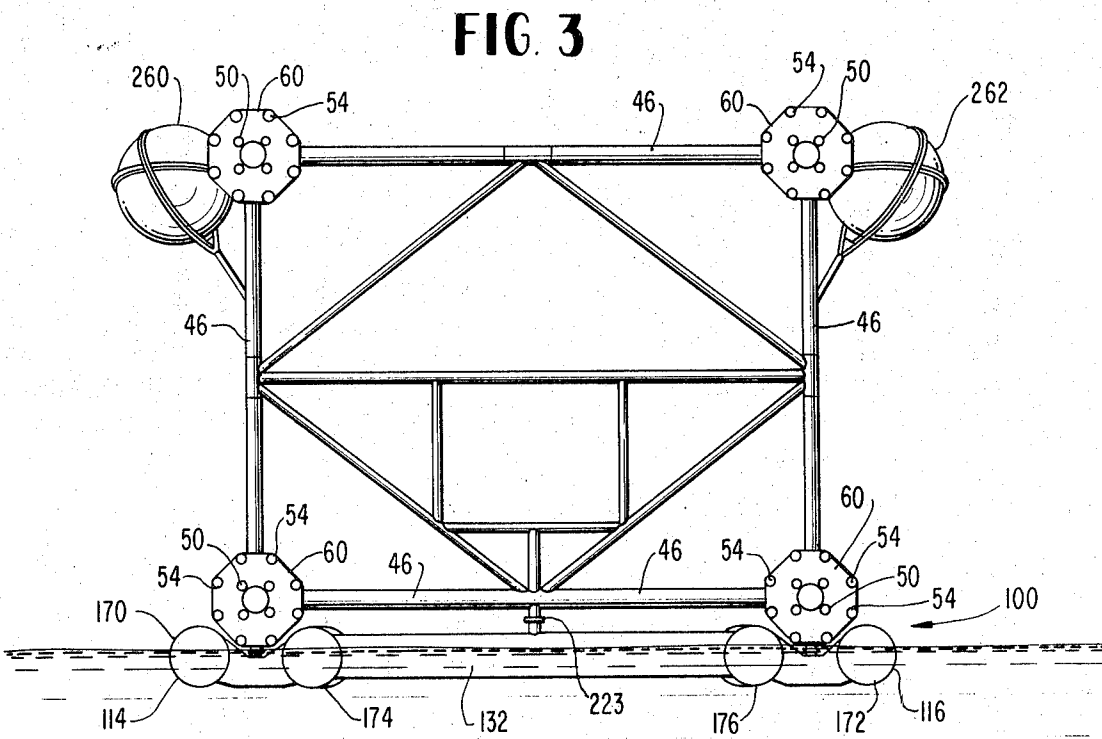
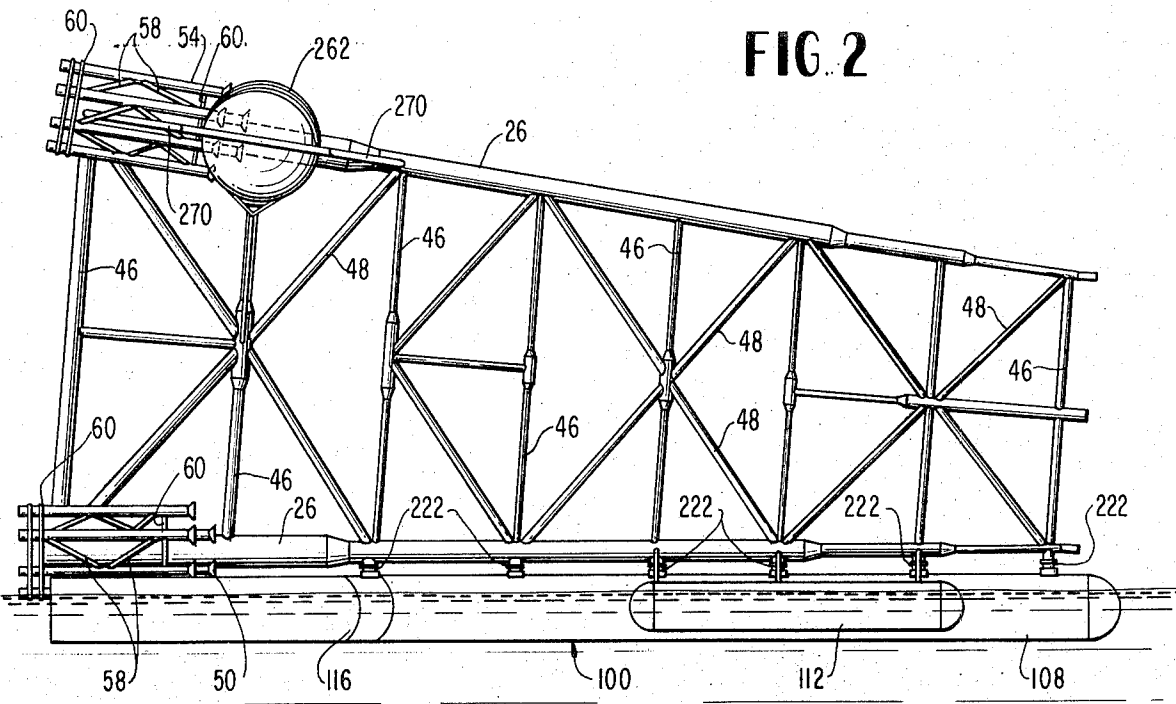


FIG. 4

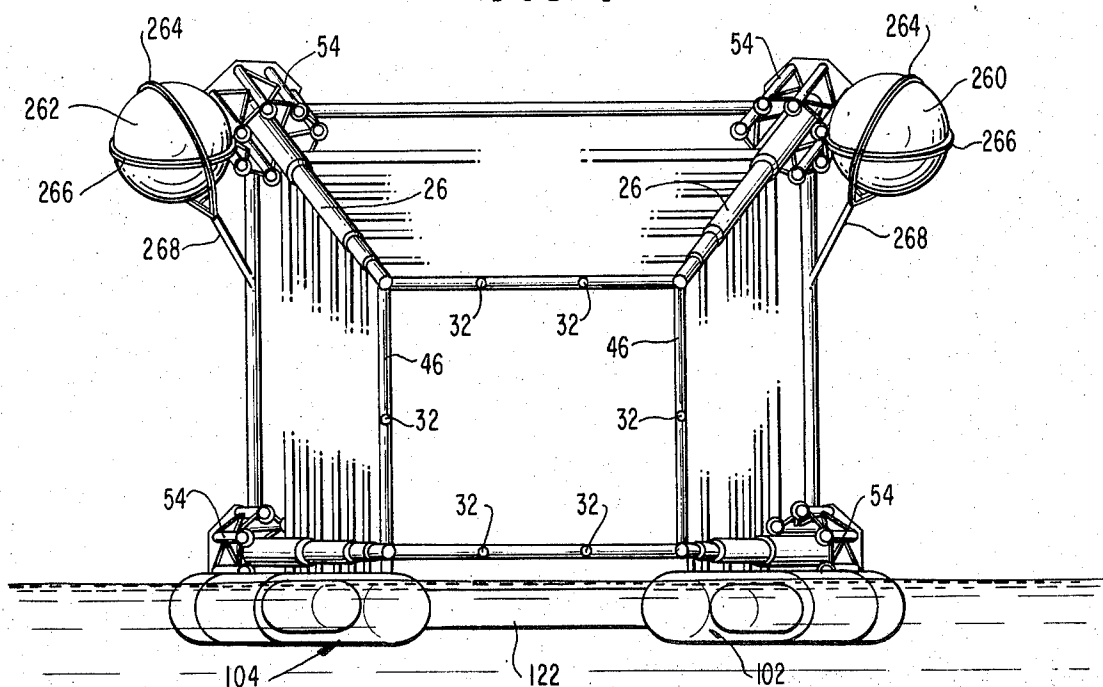


FIG. 8

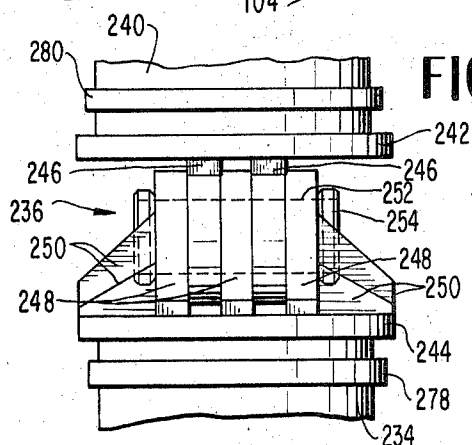


FIG. 6

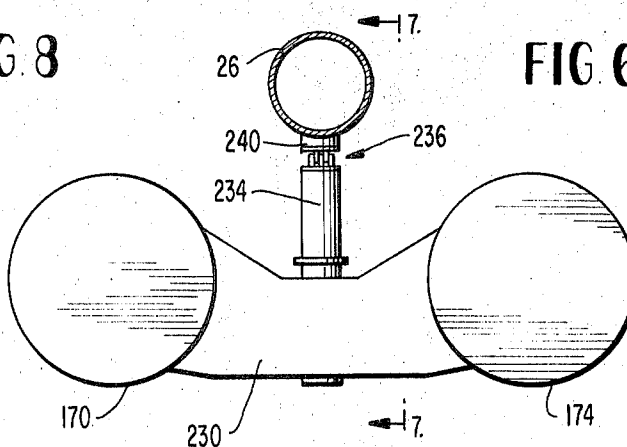


FIG. 9

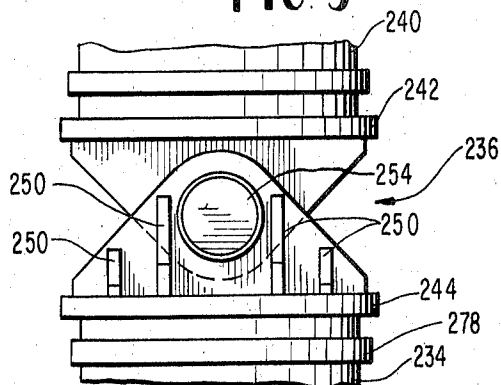


FIG. 7

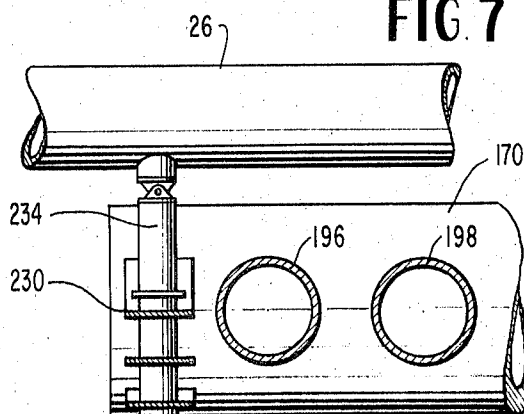


FIG. 5

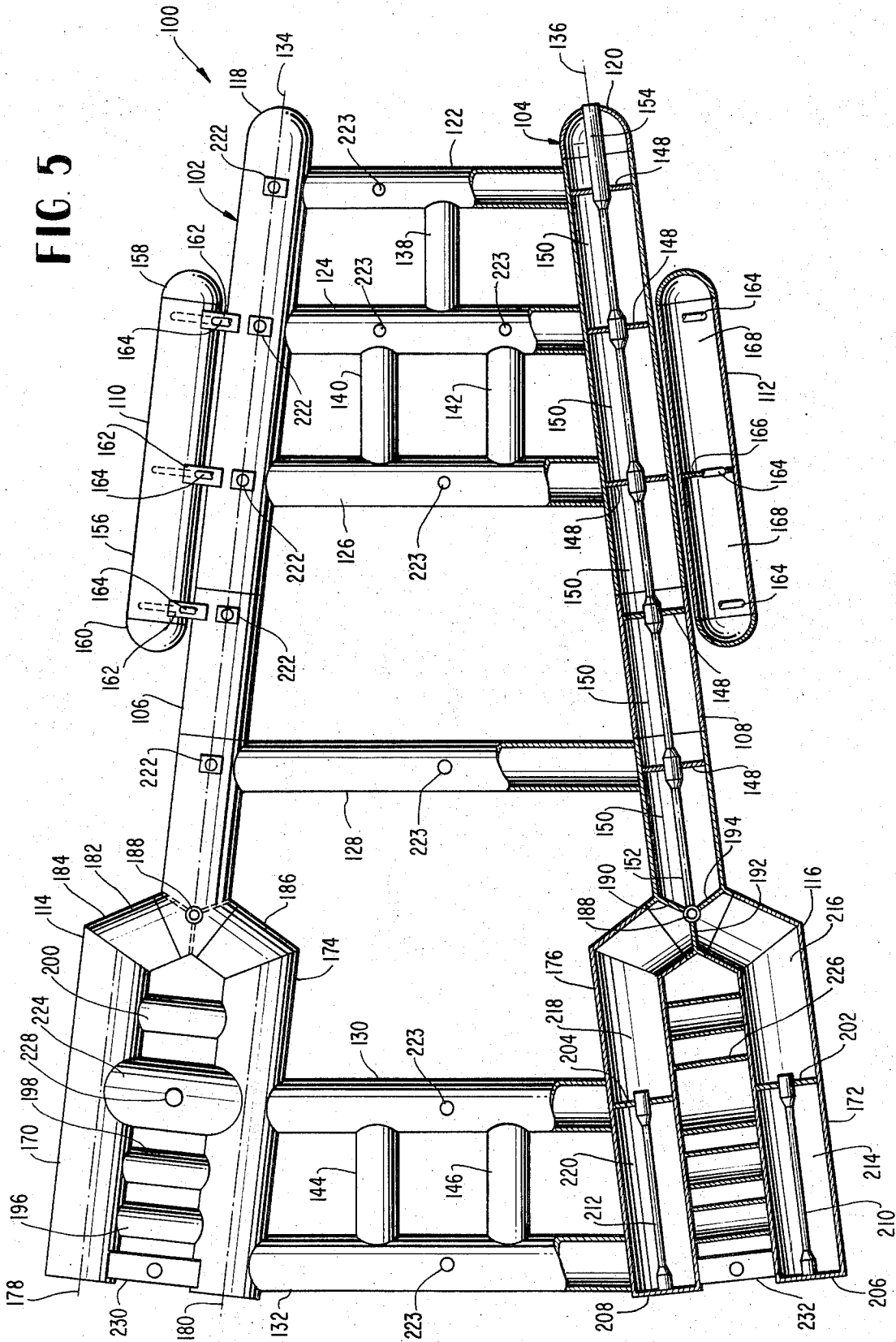


FIG. 10A

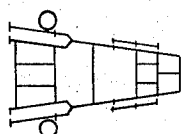


FIG. 10B

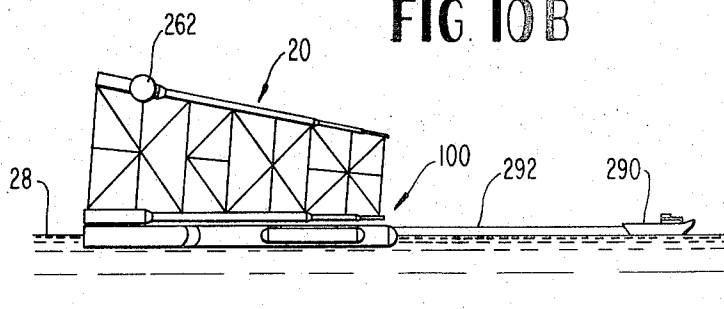


FIG. 11A

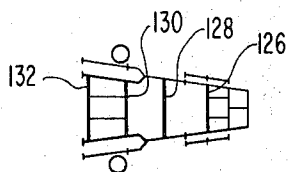


FIG. 11B

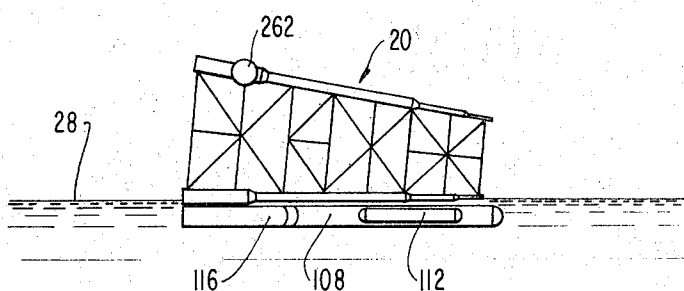


FIG. 12A

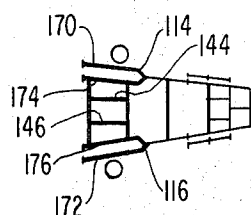


FIG. 12B

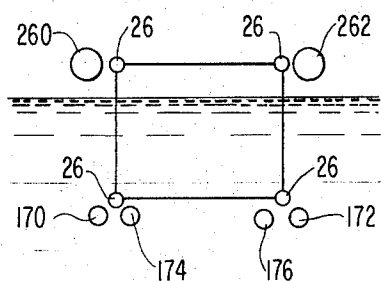
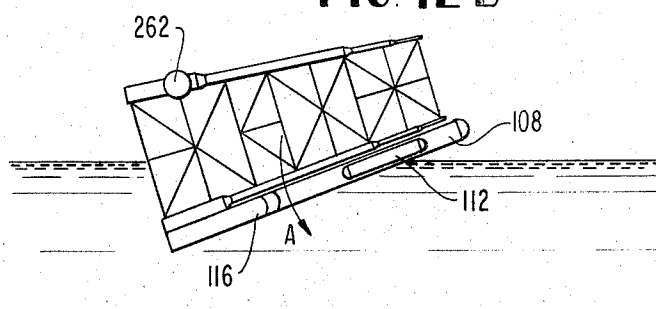


FIG. 12C

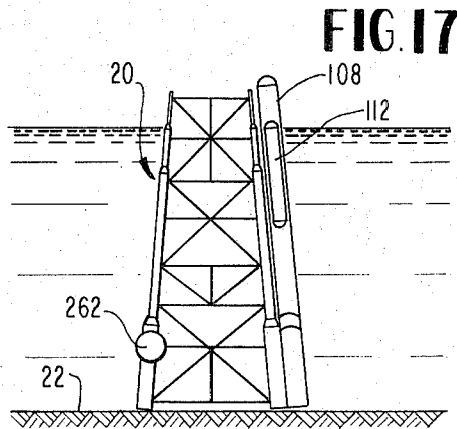
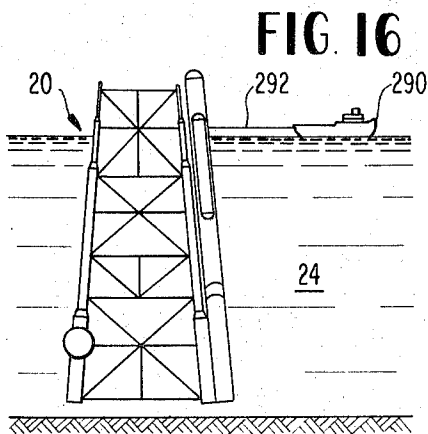
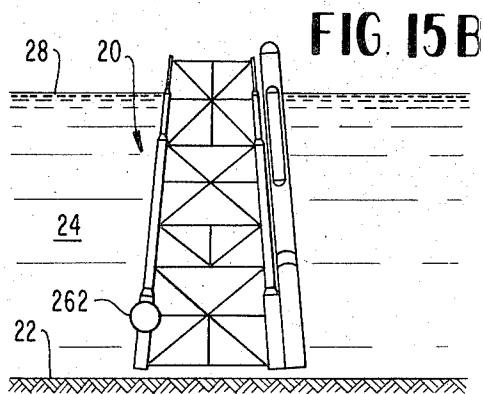
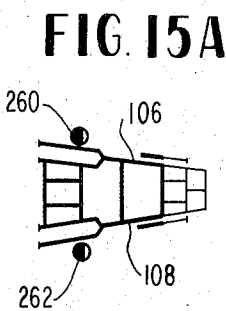
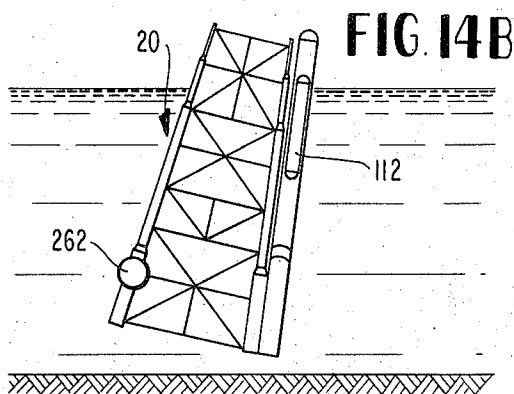
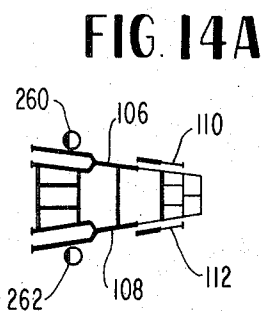
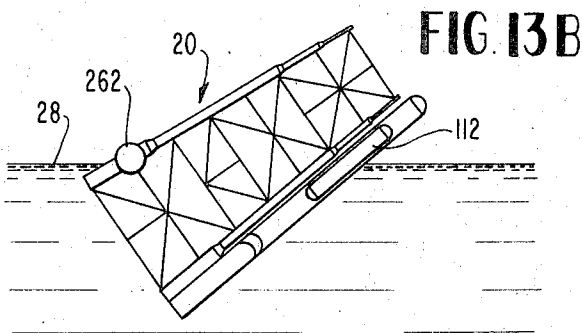
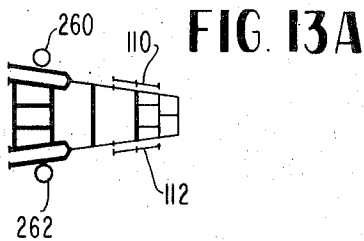


FIG. 18

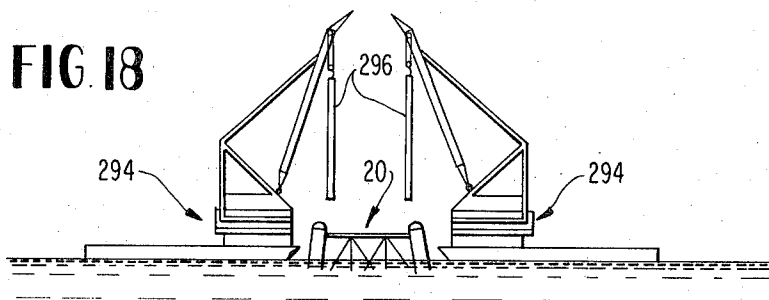


FIG. 19A

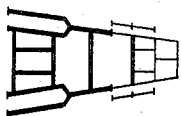


FIG. 19B

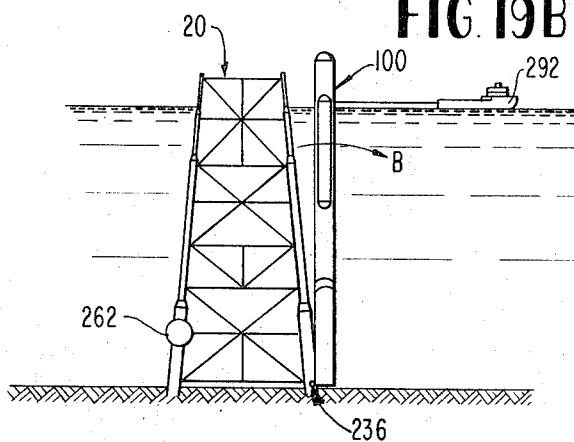


FIG. 20

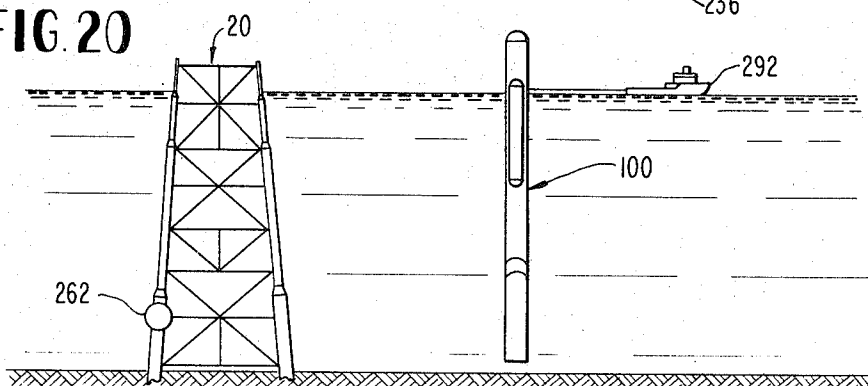
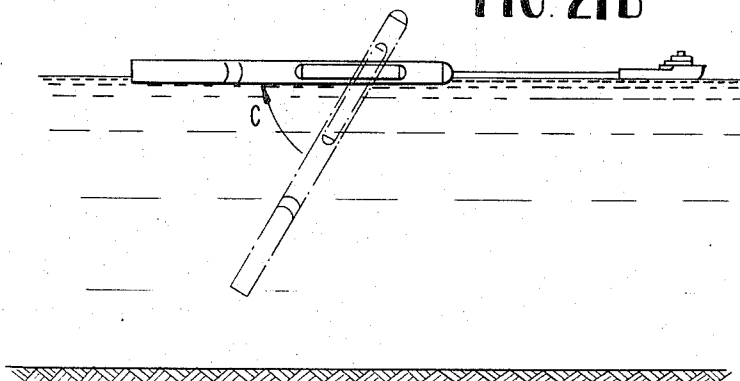


FIG. 21A



FIG. 21B



METHOD AND APPARATUS FOR TRANSPORTING AND LAUNCHING AN OFFSHORE TOWER

RELATED APPLICATION

This application is related to and is a continuation-in-part of applicants' copending application, Ser. No. 336,276, filed Feb. 27, 1973, and captioned "Method and Apparatus for Transporting and Launching an Offshore Tower." The entire disclosure of this copending application is hereby incorporated by reference as though set forth at length.

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for transporting and launching an offshore tower. More particularly the invention relates to an improved transport and launch process and apparatus for safely and efficiently transporting a large offshore tower to a pre-selected marine site, positioning the offshore tower upon the bed of a body of water and then recovering the apparatus for subsequent reuse.

In the past, steel frame towers have been advantageously utilized in a multiplicity of marine applications. Illustrative examples of effective offshore tower utilization include supports for radar or sonar stations, light beacons, scientific and exploration laboratories, etc. Additionally, offshore towers are frequently employed in the oil industry in connection with offshore drilling, production and distributing operations.

In this connection, in attempting to keep pace with burgeoning worldwide power requirements, drilling for minerals in formations situated within the bed of a body of water has become an extremely active and important segment of the oil industry. In exploiting the potential of the seabed, creative scientists and engineers have made tremendous strides with respect to exploration, drilling, producing, storing and distributing activities in an environment often referred to as the last earth frontier. Notwithstanding, however, successes of the recent past, significant challenges remain in this increasingly active segment of the oil industry.

In the initial stages of offshore development exploration and drilling operations were conducted in locations of relatively shallow water depths such as from a few feet to 100 or more feet. Productive shallow water areas exist, for example, along the near shore portions of the Gulf of Mexico. It has more recently, however, been the accepted practice to explore and develop sites in water depths from a few hundred to a thousand or more feet. Examples of deeper water fields may be found along the Pacific Coast continental shelf, the Arctic regions, the North Sea, etc.

In order to exploit mineral resources which exist below such substantial depths of water, tower designs which have been reliable and effectively utilized in the past have undergone redesign for prolonged high stress, deep water use. In this connection, recently designed offshore towers are truly enormous structures presenting significant engineering challenges not only from an initial design aspect but from a subsequent transportation and erection point of view.

At least one presently known method for transporting and erecting an offshore tower comprises interiorly segmenting the tower legs, with bulkheads and floating the tower to an offshore site upon the buoyant tower

legs. At the working site the compartments are flooded to sink the tower to the bed of the body of water.

While this technique has been utilized with at least a degree of success, increasing attention has been focused upon separation of the offshore tower and apparatus for transporting and launching the tower. In this connection if the transport and launch apparatus may be repetitively used substantial savings may be realized in connection with the transport and launch structure per se. Moreover, removing dead weight steel from a tower once launched will facilitate resistance of the tower to hydrodynamic and seismic forces.

At least one previously known transport and launch apparatus which has been designed to be recoverable includes a generally rectangular structure comprising two lower floats composed of three parallel tubes and a pair of upper floats connected to the lower floats by vertically extending columns. An offshore tower to be transported and launched is coaxially held within the surrounding floatation structure by releasable connections mounted upon cross arms extending between the floats.

While such a structure provides a degree of theoretical appeal, room for significant improvement remains. In this connection it would be desirable to provide a simplified structure which would minimize the amount of material used for the transport and launch apparatus per se. Further, it would be desirable to lower the profile of the offshore tower with respect to the surface of the body of water during transportation to increase stability and minimize wind resistance. It would also be desirable to enhance the ability of the transport and launch apparatus to be towed along the surface of the body of water. Still further it would be highly desirable to provide a transport and launch apparatus which may be released from a connecting relationship with an erected offshore tower while minimizing the possibilities of the transport and launch apparatus being hydrodynamically driven into the tower following the releasing operation. Additionally, it would be desirable to provide a method and apparatus for launching an offshore tower wherein the erecting procedure may be facilitated from a safety and predictability point of view.

At least one method and apparatus which provides significant utility in alleviating problems of the foregoing type is disclosed in applicants' previously noted copending application. Notwithstanding, however, the believed significant advance provided in the offshore art by applicants' prior method and apparatus still further notable advances may be made. For example, it would be highly desirable to enhance the roll stability of the tower during both the transport and launch phases of operation. Further it would be desirable to maximize control during a righting operation.

OBJECTS AND SUMMARY OF THE INVENTION

Objects:

It is therefore a general object of the invention to provide a novel method and apparatus for transporting and launching an offshore tower which will obviate or minimize problems of the type previously described.

It is a particular object of the invention to provide a novel method and apparatus for controllably transporting and launching an offshore tower within a body of water.

It is a further object of the invention to provide a novel method and apparatus for transporting and

launching an offshore tower which will facilitate stable towing of the offshore tower within a body of water.

It is yet a further object of the invention to provide a novel method and apparatus for transporting and launching an offshore tower which will facilitate towing alignment along a preselected navigational route.

It is still further an object of the invention to provide a novel method and apparatus for transporting and launching an offshore tower which will minimize hazards to equipment and personnel during a launching operation.

It is yet still a further object of the invention to provide a novel method and apparatus for transporting and launching an offshore tower which will optimize control of the offshore tower during a righting and essentially vertical lowering operation.

It is another object of the invention to provide a novel method and apparatus for transporting and launching an offshore tower which will minimize roll tendencies of the offshore tower during a righting operation.

It is yet another object of the invention to provide a novel method and apparatus for transporting and launching an offshore tower wherein the apparatus may be quickly removed from the offshore tower following a launch sequence for reuse in subsequent operations.

It is still another object of the invention to provide a novel method and apparatus wherein the apparatus may be reliably removed from the offshore tower following a launching operation without structurally damaging the offshore tower.

It is yet still another object of the invention to provide a novel method and apparatus for transporting and launching an offshore tower which will be highly rugged in structural design of the type capable of withstanding strong hydrodynamic forces during a transport and launch operation.

Brief Summary of the Invention:

An offshore tower transport and launch apparatus according to a preferred embodiment of the invention which is suitable to achieve at least some of the foregoing objects comprises a first and second tubular buoyancy member, each of which is releasably connected to at least one leg of the offshore tower. The first and second tubular buoyancy members are transversely interconnected along the lengths thereof to operably unify the members together. First and second auxiliary tubular buoyancy members are connected to the outboard sides of the first and second tubular buoyancy members respectively for augmenting the buoyancy and stability of the transport and launch apparatus. First and second spherical buoyancy chambers are connected to a base portion of the offshore tower in positions substantially opposed to base portions of the first and second tubular buoyancy members. Means are connected to the first and second tubular buoyancy members, the first and second auxiliary tubular buoyancy members, and the first and second spherical chambers for operably controlling the buoyancy thereof whereby an offshore tower may be transported to a marine site in a generally horizontal posture and controllably launched at the preselected marine site into a generally vertical posture onto the bed of the body of water.

The method of transporting and launching an offshore tower according to the invention comprises the steps of floating an offshore tower to a preselected marine site upon a buoyancy assembly including tubular

and spherical buoyancy chambers. After reaching the preselected offshore site, at least a portion of the tubular buoyancy chambers at the base of the offshore tower are ballasted and thereby pitching the offshore tower about first and second auxiliary tubular buoyancy members until first and second spherical buoyancy chambers engage the surface of the body of water. The method further includes ballasting the first and second spherical buoyancy chambers to right the offshore tower within the body of water and further ballasting the spherical and tubular buoyancy members to lower the righted offshore tower onto the water bed. The final step entails removing at least the tubular buoyancy members from the offshore tower for subsequent reuse.

THE DRAWINGS

Other objects and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view of a completed offshore tower resting upon the bed of a body of water and projecting above the surface thereof for supporting a multideck platform suitable for sustained offshore drilling, production and secondary recovery operations;

FIG. 2 is a side elevational view of an offshore tower positioned for transportation to a preselected marine site upon a transport and launch apparatus forming the subject matter of the instant invention;

FIG. 3 is an end view disclosing the base end of the offshore tower and transport and launch apparatus disclosed in FIG. 2;

FIG. 4 is an end view of the top portion of the offshore tower and transport and launch apparatus disclosed in FIG. 2;

FIG. 5, note sheet 4, is a plan view of a portion of the transport and launch apparatus of the subject invention, partially broken away, including two elongate tubular members fashioned with unitary tubular sections and bifurcated base sections and an inner concentric reinforcing column between a plurality of longitudinally spaced bulkheads and further including a pair of auxiliary tubular support members mounted upon the outboard side of the unitary tubular sections;

FIG. 6, note sheet 3, is a partial detailed view of a pivotal connecting assembly for mounting the bifurcated section of the transport and launch apparatus to a base portion of an offshore tower leg;

FIG. 7 is a cross sectional view taken along section line 7-7 in FIG. 6;

FIG. 8 is a detailed view of a pivotal connecting assembly including a circumferentially extending shaped charge to sever the pivotal connecting assembly extending between the transport and launch apparatus and the offshore tower;

FIG. 9 is a detailed side elevational view of the pivotal connection assembly disclosed in FIG. 8;

FIGS. 10-21 disclose a method for transporting and launching an offshore tower according to a preferred embodiment of the invention as follows:

FIGS. 10A-B disclose an offshore tower positioned upon a transport and launch apparatus for towing to a preselected marine site by one or more towing vessels of tugs;

FIGS. 11A-B disclose ballasting transverse interconnecting members of the transport and launch apparatus

as indicated in heavy lines in FIG. 11A to lower the profile of the tower and launch apparatus within the body of water;

FIGS. 12A-C disclose simultaneously ballasting the bifurcated sections and the interconnecting tubular buoyancy members that connect adjacent base transversely extending buoyancy chambers to rapidly pitch the offshore tower generally about the auxiliary tubular buoyancy members downwardly into the body of water in a rapid procedure which will minimize tendency of the tower to roll;

FIGS. 13A-B disclose the conclusion of the rapid pitching operation wherein the tower is stably supported in an inclined posture at four bearing points comprising the first and second spherical buoyancy chambers and the first and second auxiliary buoyancy chambers;

FIGS. 14A-B disclose trimming ballast within the first and second spherical buoyancy chambers, the first and second unitary tubular buoyancy members, and the first and second auxiliary buoyancy chambers to complete the righting operation;

FIGS. 15A-B disclose final trimming of ballast within the first and second spherical buoyancy chambers, the first and second unitary tubular buoyancy members, and the first and second auxiliary buoyancy chambers to finalize the righting process;

FIG. 16 discloses towing of the tower in a substantially vertical posture for final positioning and orientation of the tower at the preselected offshore site;

FIG. 17 discloses a final vertical lowering of the tower onto the bed of a body of water;

FIG. 18 discloses placing and driving pin piles through the pile jackets connected at the base of the offshore tower;

FIGS. 19A-B disclose disconnecting ties between the lateral surface of the tower legs and the transport and launch apparatus and partially deballasting the transport and launch apparatus to induce a rotation thereof upon base pivotal connecting assemblies into a generally vertical posture;

FIG. 20 discloses towing the transport and launch apparatus by the upper end thereof away from the offshore tower; and

FIGS. 21A-B disclose deballasting select sections of the transport and launch apparatus to raise the apparatus to a horizontal posture floating upon the surface of the body of water for transportation back to an offshore tower fabrication yard.

DETAILED DESCRIPTION

General Tower Structure:

Referring now to the drawings, and more particularly to FIG. 1 thereof, a typical steel frame offshore tower 20 is illustrated in a functionally operative posture situated upon the bed 22 of a body of water 24.

The tower 20 includes a plurality of upright supporting columns or legs 26 which typically slope inwardly as they project upwardly. The legs 26 are axially dimensioned to extend between the water bed 22 and the water surface 28 for supporting a working platform 30 or the like.

The platform 30 may be connected to the tower legs 26 through the provision of generally vertical riser columns 32 which facilitate construction of the platform and also ensure that the platform is sufficiently ele-

vated to be statistically free of direct hydrodynamic loading in the even of rough seas.

The offshore tower 20, as previously discussed, may be utilized in a multiplicity of applications such as, for example, to support radar stations, light beacons, marine exploration labs and the like. More predominantly, however, offshore towers of the type illustrated and described are utilized in the offshore oil industry to support platforms for drilling, producing, storing, distributing and secondary recovery operations.

In this connection the platform 30 frequently is composed of at least two decks, including a main deck 34 and a cellar deck 36. The main deck may serve to support one or more drilling rigs 40 which may be suitable to drill from a plurality of locations and inclinations with respect to the platform 30. Further, the main deck typically is provided with one or more pedestal cranes 42 and 44, mud tanks and various other equipment suitable for sustaining a continuous drilling operation. The cellar deck 36 typically contains housing units, generators, compressors, control centers, test facilities and the like.

The supporting columns or legs 26 are laterally stabilized by a plurality of transversely extending brace members 46. Vertical tower loading is distributed throughout the structure by a network of struts 48 interconnecting the braces 46 and the tower legs 26.

The tower 20 is further provided at the base of each leg 26 with a plurality of pinning pile guides 50. The pile guides 50 are attached directly to the lowermost portion of the tower legs and are suitable to receive pinning piles which may be rapidly driven in place immediately following positioning of the tower at a preselected offshore site in a desired orientation.

Once the tower is pinned in an upright posture, permanent piles 52 are driven through a plurality of pile guides 54 which are placed in a peripheral ring about the base of each tower leg. The permanent pile guides 54 are structurally united by a plurality of sloping struts 58 and are joined to the pinning pile guides and base portions of the offshore tower legs by the provision of mounting collars 60.

The diameters of the pilings 52 and permanent pile guides 54 are such that a concentric volume is formed between the exterior surface of the piling and the interior surface of the piling guides. This volume may be suitably filled with a grouting composition or the like to fixedly couple the pilings to the pile guides and thus secure the collar structure to the bed of the body of water.

In many instances grouting composition alone is sufficient to fixedly interconnect the pilings with the piling guides. In some instances, however, it may be desirable to weld annular rings (not shown) about the outer periphery of the pilings and the inner periphery of the jacket. The rings may be provided with sloping fingers designed to bind with the grouting composition and ensure a secure interlock between the piles and the pile guides. For a more detailed description of the above outlined grouting technique and structure, reference may be had to a United States Hauber et al U.S. Pat. No. 3,315,473, issued Apr. 25, 1967, and assigned to the assignee of the subject application. The disclosure of the Hauber et al patent is hereby incorporated by reference as though set forth at length.

The tower and platform of the foregoing description are intended to be merely illustrative of currently uti-

lized offshore tower designs and do not per se form a part of the subject transport and launch invention which will now be discussed in detail.

Transport and Launch Apparatus:

A transport and launch apparatus according to a preferred embodiment of the invention which is advantageously operable to transport and launch a tower of the type previously described is disclosed in FIGS. 2-5.

More specifically, the transport and launch apparatus comprises a lower watertight buoyancy assembly 100 suitable to support an offshore tower in a generally horizontal posture substantially above the surface 28 of a body of water 24. The lower buoyancy assembly includes a first watertight tubular buoyancy member 102 and a second watertight tubular buoyancy member 104. The tubular buoyancy members 102 and 104 include unitary tubular sections 106 and 108, auxiliary tubular buoyant sections 110 and 112 and bifurcated tubular buoyancy sections 114 and 116 respectively.

The free ends of the unitary tubular sections 106 and 108 are enclosed with hemispherical nose sections 118 and 120 which facilitate towing of the apparatus through the body of water. The first and second tubular buoyancy members 102 and 104 are interconnected by a plurality of transversely extending tubular buoyancy members 122, 124, 126, 128, 130 and 132. Transverse buoyancy members 122, 124, 126 and 128 are fixedly connected between the unitary tubular sections 106 and 108, while transverse buoyancy members 130 and 132 interconnect the bifurcated tubular sections 114 and 116.

The axial dimensions of the transverse tubular buoyancy members 122-132 are such that a central longitudinal axis 134 of the first tubular buoyancy member 106 is slopingly inclined with respect to a central longitudinal axis 136 of the second tubular buoyancy member 108 from the bifurcated ends of the tubular buoyancy members toward the free ends thereof with a slope compatible with that of the tower legs 26 of an offshore tower to be transported and launched by the apparatus.

The transversely extending tubular buoyancy members at the upper end of the transport and launch apparatus 122, 124 and 126 are interconnected by tubular buoyancy members 138, 140 and 142. These tubular buoyancy members have central longitudinal axes extending approximately normal to and intersecting the central longitudinal axes of the transversely extending members 122-126.

In a similar manner the lowermost transversely extending tubular buoyancy members 130 and 132 are interconnected by tubular buoyancy members 144 and 146. Tubular buoyancy members 144 and 146 have central longitudinal axes extending normal to and intersecting the central longitudinal axes of the transversely extending tubular buoyancy members 130 and 132.

The first and second unitary tubular sections 106 and 108 of the first and second buoyancy members 102 and 104 are provided with a plurality of transversely extending bulkheads 148 along the axial lengths thereof, note the broken away portion of FIG. 5. The bulkheads 148 serve to divide the tubular portions 106 and 108 into a plurality of generally uniformly dimensional ballast compartments 150.

The bulkheads 148 are supported by a column 152 which coaxially extends throughout the length of the unitary tubular portions 106 and 108.

The interior coaxial column 152 provides columnar support for the bulkheads 148 and also serves as a conduit for carrying control lines (not shown) to each of the compartments 150. More specifically, conventional ballasting and deballasting valves, ballast sensing devices, and the control supply lines therefor, are connected into each of the compartments 150, so that ballast within each compartment may be controllably regulated by well known techniques.

In addition to the buoyancy chambers 150, the transversely extending tubular buoyancy members 122, 124, 126, 128, 130, 132 and interconnecting tubular buoyancy members 138, 140, 142, 144 and 146 are each fitted with ballasting and deballasting valves and remote controls. Accurate ballasting and deballasting of each of these chambers may be monitored from a central control chamber 154 fashioned within the nose portion of unitary tubular member 108.

As previously noted, in addition to the unitary tubular members 106 and 108, the first and second watertight tubular buoyancy members 102 and 104 are provided with auxiliary tubular buoyancy members 110 and 112, respectively.

More specifically, each of the auxiliary tubular buoyancy members includes a cylindrical outer shell 156 and hemispherical end caps 158 and 160 which enclose the auxiliary chamber to form a watertight buoyancy member. The auxiliary tubular buoyancy members are fixedly connected to the outboard surfaces of the unitary tubular buoyancy members 106 and 108 by the provision of bridging members 162 and supporting tubular struts 164.

Each of the auxiliary tubular buoyancy members is provided with at least one transversely extending internal bulkhead 166 (note the broken away representation in FIG. 5). In a manner similar to that with the previously discussed tubular buoyancy members, the bulkhead 166 is suitable to divide the auxiliary tubular buoyancy members into smaller buoyancy chambers 168. Each of the smaller, buoyancy chambers 168 is fitted with ballast and deballast valves and ballast sensing devices along with control and supply lines sufficient in character to accurately control buoyancy within the auxiliary tubular buoyancy chambers.

Further, as previously mentioned, the first and second watertight tubular buoyancy members 102 and 104 are provided with bifurcated tubular end sections 114 and 116. Both of the bifurcated tubular sections 114 and 116 are similarly fabricated and include outboard watertight tubular members 170 and 172 and inboard watertight tubular members 174 and 176, respectively.

Referring now particularly to the bifurcated tubular section 114, the outboard tubular member 170 and the inboard tubular member 174 have mutually parallel central longitudinally extending axes 178 and 180, respectively. The parallel extending tubular members 170 and 174 are interconnected at one of the ends thereof to the end of the unitary tubular section 106 by the provision of a transversely extending bite or bridge section 182.

The bridge section 182 includes a first inclined tubular portion 184 which extends between one end of the outboard tubular member 170 and one end of the unitary tubular member 106. In a similar manner a sloping tubular member 186 is connected between one end of the inboard tubular buoyancy member 180 and one end of the unitary tubular buoyancy member 106.

In order to provide structural support at the junction of the tubular members **184**, **186** and **106**, a cylindrical structural key **188** is normally positioned at the intersection of the central longitudinal axes of the tubular members. Generally semicircular bulkhead plates **190**, **192** and **194** (note bifurcated portion **116**), are then interconnected between the key **188** and the intersection surfaces of the cylindrical tubular members.

The mutually parallel tubular members **170** and **174** are structurally utilized by the provision of a plurality of transversely extending brace members **196**, **198** and **200**.

As previously stated the construction of the bifurcated tubular section **114** is identical with that of the bifurcated tubular section **116** and therefore the discussion with respect to section **114** is equally applicable with respect to that of section **116**, and vice versa.

In this connection, the bifurcated tubular section **116**, as shown in a broken away view, discloses transversely extending interior bulkheads **202** and **204** positioned within the interior of tubular sections **172** and **176**, respectively, to divide each leg into upper and lower buoyancy chambers **214**, **216**, **218** and **220**. Moreover the free ends of each leg **172** and **176** are provided with end caps **206** and **208**, respectively, to provide watertight integrity for the bifurcated tubular section. Cylindrical columns **210** and **212** extend between the end plate **206** and bulkhead **202** and the end plate **208** and bulkhead **204**, respectively, to reinforce the bulkheads and provide access for control systems utilized to actuate and deactuate ballast and deballast valves, ballast sensing equipment (not shown) all of a conventional type suitable to accurately regulate the buoyancy of the chambers **214**, **216**, **218** and **220**.

As previously discussed, the foregoing described transport and launch apparatus is designed to carry an offshore tower **20** in a generally horizontal posture over the surface of a body of water (note FIGS. 2-4), and erect the tower in a generally vertical posture upon the bed of a body of water (note FIG. 1). In order to achieve these desired functions it is necessary to connect the offshore tower **20** to the transport and launch apparatus **100**. In this regard a plurality of normally extending columns or mounting pillars **222** are disposed along the upper lateral surface of the unitary tubular members **106** and **108** (note FIGS. 2, 4 and 5). These columns are fashioned with upper arcuate surfaces to intimately engage with and be welded to the tower leg **26**. The same connection of columns **222** with the tower leg **26** serves to rigidly interconnect the tubular member **106** and **108** with legs **26** of an offshore tower **20** to be transported.

In a similar manner transversely extending tubular buoyancy members **122**, **124**, **126**, **128**, **130** and **132** are each provided with normally extending supporting columns **223** which are welded to tower braces **46**.

Further, the base portion of the offshore tower **20** may be secured to the transport and launch apparatus **100** by disposing the clusters of piling guides **54** the bifurcated tubular members and connecting the base portion of the tower legs to ruggedize tubular bridges **224** and **226** extending between the legs of the bifurcated sections **104** and **116**, respectively. The ruggedized bridges **224** and **226** carry upright mounting columns **228** having coped ends dimensioned to be fixedly welded to the base portions of the tower legs. The lowermost portion of the offshore tower legs are connected

to the transport and launch apparatus **100** by the provision of pivotal assemblies which are specifically illustrated in FIGS. 5-9.

More particularly, the free ends of the bifurcated tubular sections are interconnected by bridges **230** and **232**. The bridges serve to carry upwardly extending columns **234**.

A pivotal assembly **236** is mounted at the top of columns **234** and connects directly at extension **240** mounted upon a base portion of tower legs **26**.

By reference now to FIGS. 8 and 9, there will be seen detailed views of the pivotal connecting assemblies **236**. More specifically, the extension member **240** connected between the pivotal assembly **236** and the tower leg **26** is provided on an end thereof with a flat plate **242**. In a like manner, the upper end of the column **234** is provided with a flat support plate **244**. Normally projecting from the plates **242** and **244** are apertured hinge leaves **246** and **248** respectively. The outermost leaves **248** are supported by triangular gusset braces **250**. The hinge leaves **246** and **248** are intermeshed to form an aligned aperture **252** for the reception of a heavy duty pivot pin **254**.

By the provision of the foregoing described supporting structure an offshore tower **20** may be fixedly attached to a transport and launch apparatus **100** for towing along the surface **26** of a body of water to a preselected marine site.

The towing operation is greatly facilitated by the transport and launch apparatus in at least two particulars.

In this connection, as previously mentioned, the free ends of the unitary tubular sections **106** and **108** are provided with hemispherical end caps **118** and **120**, respectively, to reduce water resistance to forward motion of the apparatus through the body of water.

Further, as best noted in FIG. 5, the transport and launch structure is generally A-shaped. By the provision of this configuration towing through the water is aided in that axial alignment of the apparatus **100** with respect to the direction of travel is automatically maintained. More particularly, if the structure were a rectangular configuration, there would be a continual tendency for the axis of the tower to shift to the port or starboard and become misaligned. Such misalignment would materially increase towing difficulties in an open sea. The A-shaped configuration of the subject invention, however, is automatically self-aligning, in that the sloping sides of the A-shaped apparatus will counter tendencies of the apparatus to rotate broadside under tow.

Once the tower has been towed to a desired preselected marine site, the next step is to launch the tower into a generally vertical posture upon the water bed, as depicted in FIG. 1. The launching operation will be discussed in detail hereinafter. For the present, however, it should be noted that the control and stability of this launching operation is materially aided by the provision of first and second spherical buoyancy chambers **260** and **262**, note FIGS. 2-4, which form a part of the transport and launch apparatus.

The spherical buoyancy chambers **260** and **262** are provided with girder rings **264** and **266** which attach to connecting braces **268** and **270**. Braces **268** and **270** are connected to the braces **46** and tower legs **26** respectively, note FIGS. 2 and 4, to securely mount the

spherical buoyancy chambers at the base of the tower 20.

The spherical buoyancy chamber 260 is mounted upon a base portion of the offshore tower in a posture substantially above the bifurcated tubular portion 114 and diametrically opposed to the bifurcated tubular portion 116. In a similar manner, the spherical buoyancy chamber 262 is mounted upon a base portion of the offshore tower in a posture substantially above the bifurcated tubular portion 116 and diametrically opposed to the bifurcated tubular section 114.

In a manner similar to the previously discussed buoyancy chambers, the first and second spherical buoyancy chambers 260 and 262 are each fashioned with ballast and deballast valves, control lines and ballast sensing equipment, so that ballast may be accurately added or removed from the spherical chambers.

Once the offshore tower has been righted into a vertical position and lowered into a resting posture upon the water bed by utilization of the foregoing discussed buoyancy chambers, it is highly desirable to remove the transport and launch apparatus as quickly as possible. In this connection, the transport and launch apparatus has been calculated to provide approximately two-thirds of the wave shear force on the tower. Therefore, it becomes almost impossible to install enough pilings in a short period of time in order to hold the offshore tower as well as the launch apparatus in place in the event rough sea conditions should arise.

In order to quickly sever the lower portion of the transport and launch apparatus 100 from the offshore tower 20, each of the columns 222 and 223 are fitted with remotely actuatable circumferentially extending shaped explosive charges. Moreover the columns 228, 234 and 240 may be similarly fitted with remotely actuatable explosive cutting assemblies.

More particularly and with reference to FIGS. 8 and 9 there will be seen circumferentially extending shaped charges 278 and 280 mounted peripherally about the columns 234 and 240, respectively. The shaped charges, as previously noted, may be remotely actuated to sever the columns 234 and 240 and release the tubular portion of the transport and launch apparatus from an erected tower. A construction of the shaped charges per se does not form a part of the subject invention and commercially available devices may be utilized.

Transport and Launch Sequence:

With particular reference now to FIGS. 10-21, a sequence of transporting, launching and erecting an offshore tower at a preselected marine site according to a preferred embodiment of the invention is illustrated.

An offshore tower 20 is constructed upon a lateral face of the lower portion of the transport and launch apparatus 100 within a fabrication or graving yard. The spherical buoyancy chambers are also mounted upon the offshore tower within the fabrication yard.

The yard facility is then flooded which raises the transport and launch apparatus up from supporting pilow frames to floatingly carry the tower 20 above the surface 28 of a body of water. In this supporting posture the tower structure 20 per se is substantially above the surface of the body of water. Therefore the braces and struts of the tower will not produce drag during a towing operation. It will be noted, however, that the tower assumes a low enough profile with respect to the water surface so that wind resistance is minimized and stability is maximized.

The ballast chambers within the lower portion of the transport and launch apparatus 100 are substantially devoid of water as depicted by the schematic 10A. It will be appreciated, however, that a small amount of ballast may be added to provide proper trim for the transport and launch apparatus.

One or more towing vessels or tugs 290 are then connected to the bow of the lower portion of the transport and launch apparatus 100 by lines 292 to tow the vessel to a preselected marine site. Upon reaching the site, the tower is righted and launched into the body of water 24 in a controlled and rapid manner which will now be discussed in detail.

A first step in the launching sequence is to lower the profile of the tower with respect to the surface 28 of a body of water. This may be achieved by flooding transverse ballast chambers 126, 128, 130 and 132, note FIGS. 11A-B.

Once the tower 20 is lowered with respect to the surface of the body of water, it is desirable to pivot or pitch the tower into a generally vertical configuration within the body of water in a rapid yet controllable manner in order to minimize the tendency of the tower to unpredictably roll about its central axis to either port or starboard. In this connection it will be appreciated that an uncontrollable roll tendency of a massive tower which may be 500 or more feet in length is highly dangerous to nearby vessels and personnel.

In order to minimize this unpredictable port or starboard roll tendency the tower is pitched rapidly from a generally horizontal posture as depicted in FIG. 11B to a posture as depicted in FIG. 13B. In order to achieve this rapid pitch, the inboard 174 and 176 and outboard 170 and 172 tubular buoyancy tanks of the first bifurcated section 114 and second bifurcated section 116, respectively, of the transport apparatus are simultaneously rapidly ballasted. Moreover, the interconnecting tubular members 144 and 146 are also ballasted as rapidly as possible. Thus, as will be noted by reference to FIG. 12A, the entire base portion of the transport apparatus 100 is rapidly and simultaneously filled with ballast water. The tower will then pitch downwardly about the upper tubular buoyancy members and the first and second auxiliary tubular buoyancy members 110 and 112, as indicated by arrow A, note FIG. 12B.

Because the entire lower portion of the transport apparatus is simultaneously ballasted, the pitch in the direction of arrow A will occur rapidly enough to minimize any port or starboard roll tendency the tower might have due to a slightly uneven ballasting rate of the outboard tubular tanks of the bifurcated tubular members.

The initial pitch is terminated when the spherical buoyancy chambers 260 and 264 engage the surface 28 of the body of water. The offshore tower 20 will then tend to hang in a stabilized posture upon essentially a four point bearing of buoyancy chambers provided by the first and second auxiliary buoyancy chambers 110 and 112, and the first and second spherical buoyancy chambers 260 and 264, note FIG. 13A.

Once the tower has been rapidly pitched into posture depicted in FIG. 13B, the spherical buoyancy chambers 260 and 262, and the lower chambers 168 of the first and second auxiliary tubular buoyancy members 110 and 112 as well as the lower chambers within the unitary tubular buoyancy legs 106 and 108 may be con-

trollably ballasted to further pivot the offshore tower into a generally vertical posture as depicted in FIG. 14B.

As depicted in FIGS. 15A and B, a final trim is added to the first and second spherical buoyancy chambers 260 and 262, and individual buoyancy chambers 150 within the unitary tubular legs 106 and 108 to bring the tower 20 into a plumb posture floating contiguous to but spaced from the bed 22 of the body of water.

One or more tugs 290 may then be connected to the transport and launch apparatus by a tow line 292, note FIG. 16, in order to accurately position the tower 20 within the body of water 24, at the preselected marine site, in an orientation which will minimize, based upon predicted current flows, the imposition of hydrodynamic forces onto the tower structure (note FIG. 16). More specifically, an angle or corner of the tower 20 is desirably headed into the current to minimize the imposition of broadside hydrodynamic loading.

Once the tower 20 has been accurately positioned and oriented, it is finally lowered onto the water bed 22 by finely ballasting the unitary tubular buoyancy members, the first and second auxiliary tubular buoyancy members, and the first and second spherical buoyancy chambers of the transport and launch apparatus, note FIG. 17.

As soon as the tower 20 has been brought to rest upon the water bed 22, a pair of derrick barges 294 are rapidly pulled along side the upper portion of the tower 20 and a plurality of pinning piles 296 are lowered through guides (not shown) extending along the lateral surface of the tower legs 26 and into the previously noted pinning pile guides 50 (note FIG. 1).

The pinning piles are then driven into the water bed 22 in order to quickly pin the offshore tower to the seabed. Once the pinning operation is completed, the lower portion of the transport and launch apparatus 100 is desirably rapidly removed from the lateral face of the tower 20 for the reasons, as previously mentioned, of unloading the tower legs 26 to minimize the forces they must withstand in the event of rough sea conditions.

Removal is initiated by actuating the shaped charges which surround the supporting columns 222, 223 and 228.

The uppermost ballasting chambers 150 of the unitary tubular members 106 and 108, and the buoyancy chambers 168 of the first and second auxiliary tubular buoyancy chambers 110 and 112 are then blown in order to bring the base portion of the transport and launch apparatus 100 to a slightly positive buoyancy state in the inclined posture along the lateral face of the offshore tower 20. The slight buoyancy of the transport and launch apparatus 100 will serve to induce pivotal movement of the apparatus about the pivotal base connecting assemblies 236 in the direction of arrow B, note FIG. 19B. This pivot procedure may be facilitated by the utilization of one or more towing tugs 292.

Once the lower section of the transport and launch apparatus 100 is pivoted away from contact with the lateral surface of the offshore tower 20, the shaped charges 278 and 280 surrounding the pivotal connecting assembled 236 are actuated to completely sever the transport and launch apparatus 100 from connection with the offshore tower 20.

As soon as the neutrally buoyant transport and launch apparatus 100 is severed from the tower, it will

be appreciated that hydrodynamic forces may tend to push the apparatus into damaging bumping contact with the relatively delicate tower legs or braces and struts. Since the apparatus has been previously pivoted away from adjacency with the tower, however, this possibility is effectively minimized.

One or more tugs 202 may then tow the freely floating transport and launch apparatus 100 in a vertical posture a short distance away from the offshore tower 20. Once the transport and launch apparatus is out of the immediate vicinity of the tower, it may be refloated by blowing ballast chambers 168 in the first and second auxiliary tubular buoyancy chambers 110 and 112, the ballast chambers 214 and 220 in the lowermost sections of the first and second bifurcated tubular buoyancy sections 114 and 116 (note FIGS. 21A-B). The refloating movement is depicted by directional arrow C in FIG. 21B. Subsequent to refloating the lower portion of the transport and launch apparatus, the ballast chambers may all be blown or deballasted to a proper trim for transportation of the apparatus back to a graving dock for subsequent reuse.

Once the lower portion of the transport and launch apparatus 100 is removed from the offshore tower, the tower is completed by adding a platform structure 30 as previously discussed and inserting, driving and grouting permanent piles 52 through the plurality of pile guides 54 surrounding each of the tower legs 26.

While the lower portion of the transport and launch apparatus 100 is a massive structure of tubular buoyancy conduits and thus substantially increases hydrodynamic loading of the tower legs, the spherical buoyancy chambers 260 and 262 are relatively streamlined and submerged adjacent the base of the offshore tower. These buoyancy spheres do not present significant problems in connection with loading of the tower legs. Therefore the spheres may be left connected to the tower in a submerged posture. In the event it is desired, at some point in time, to recapture the spheres for subsequent reuse, they may be severed and controllably deballasted and raised to the surface.

SUMMARY OF THE MAJOR ADVANTAGES OF THE INVENTION

In describing the foregoing method and apparatus constituting a preferred embodiment of the invention, various advantageous aspects have been delineated.

A principal advantage of the invention resides in the utilization of first and second auxiliary low pressure tubular buoyancy members and first and second spherical high pressure chambers which are advantageously utilized during a righting operation to stabilize an offshore tower and minimize unpredictable roll tendencies during the righting operation.

Another principal advantage of the invention is the provision of transverse tubular buoyancy chambers and interconnecting tubular buoyancy chambers which may be rapidly ballasted along with bifurcated tubular chambers to rapidly pitch an offshore tower into a body of water and minimize roll tendencies of the offshore tower.

Another significant advantage of the present invention is the provision of a novel transport and launch apparatus for facilitating stable and aligned transportation of an offshore tower through a body of water. Further significant advantages reside in the novel process and apparatus for rapidly removing the launch appara-

tus from a righted tower so as to minimize hydrodynamic loading upon the offshore tower legs and permit reuse of the launch apparatus in subsequent operations.

Because the transport and launch apparatus is designed to be fixed in a contiguous posture along a lateral surface of the offshore tower, a minimum amount of connecting structure is required to attach the floatation portion of the transport and launch apparatus to the offshore tower. Additionally, the transport and launch structure per se is designed to be highly rugged to withstand considerable hydrodynamic forces of the sea. Further the spherical high pressure chambers are structurally highly efficient in design and minimize the weight of the transport and launch apparatus.

Additionally, by the provision of the pivotal connection of the transport and launch apparatus with the base of the offshore tower, the apparatus may be pivoted away from adjacency with the upper portion of the offshore tower, prior to completely releasing the transport and launch apparatus thus minimizing the possibility of hydrodynamic forces pushing the apparatus into damaging bumping contact with the upper portion of the offshore tower.

Yet another significant advantage of utilization of the subject transport and launch apparatus in the general sequence as described will enable an offshore tower to be transported and launched into a generally vertical posture and positioned upon the bed of a body of water with a minimum hazard to equipment and personnel during the operation.

While the invention has been described with reference to preferred embodiments, it will be appreciated by those skilled in the art that additions, deletions, modifications and substitutions or other changes not specifically described may be made which will fall within the purview of the appended claims.

What is claimed is:

1. An offshore tower transport and launch apparatus comprising:
 - a first tubular buoyancy member including,
 - a unitary tubular section, and
 - a bifurcated tubular section connected to said unitary section at one end thereof;
 - means for connecting said first tubular buoyancy member to at least one leg of the offshore tower;
 - a second tubular buoyancy member including,
 - a unitary tubular section, and
 - a bifurcated tubular section connected to said unitary section at one end thereof;
 - means for connecting said second tubular buoyancy member to at least another leg of the offshore tower;
 - means transversely interconnecting said first and second tubular buoyancy members at spaced intervals along the length of said first and second tubular buoyancy sections;
 - first auxiliary tubular buoyancy means connected to the outboard side of said unitary tubular section of said first tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus;
 - second auxiliary tubular buoyancy means connected to the outboard side of said unitary tubular section of said second tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus;

means connected to at least said first and second tubular buoyancy members for operably controlling the buoyancy thereof, whereby an offshore tower may be transported to a marine site in a generally horizontal posture substantially above the surface of a body of water and launched at the preselected marine site into a generally vertical posture onto the bed of the body of water;

a first spherical buoyancy chamber connected to a base portion of another leg of the offshore tower in a posture substantially diametrically opposed to the bifurcated tubular section of said second tubular buoyancy member and generally above the bifurcated tubular section of said first tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture;

a second spherical buoyancy chamber connected to a base portion of at least another leg of the offshore tower in a posture substantially diametrically opposed to the bifurcated tubular section of said first tubular buoyancy member and generally above the bifurcated tubular section of said second tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture; and

means connected to each of said first and second spherical buoyancy chambers to control the buoyancy thereof.

2. An offshore tower transport and launch apparatus comprising:

a first tubular buoyancy member including,

- a unitary tubular section, and
- a bifurcated tubular section connected to said unitary section at one end thereof;

means for connecting said first tubular buoyancy member to at least one leg of an offshore tower, including

pivotal connecting means extending between a base portion of the offshore tower and a lowermost portion of said bifurcated tubular section;

a second tubular buoyancy member including,

- a unitary tubular section, and
- a bifurcated tubular section connected to said unitary section at one end thereof;

means for releasably connecting said second tubular buoyancy member to at least another leg of the offshore tower, including

pivotal connecting means extending between a base portion of the offshore tower and a lowermost portion of said bifurcated tubular section;

means transversely interconnecting said first and second tubular buoyancy members at spaced intervals along the length of said first and second tubular buoyancy sections;

first auxiliary tubular buoyancy means connected to the outboard side of said unitary tubular section of said first tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus;

second auxiliary tubular buoyancy means connected to the outboard side of said unitary tubular section of said second tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus; and

means connected to at least said first and second tubular buoyancy members for operably controlling the buoyancy thereof, whereby an offshore tower

may be transported to a marine site in a generally horizontal posture substantially above the surface of a body of water and launched at the preselected marine site into a generally vertical posture onto the bed of the body of water.

3. An offshore tower transport and launch apparatus as defined in claim 2 wherein said transversely interconnecting means comprise:

a plurality of tubular buoyancy members transversely spanning between said first and second tubular buoyancy members at selected locations along the length thereof; and

means connected to each of said transverse tubular buoyancy members for controlling the buoyancy thereof.

4. An offshore tower transport and launch apparatus as defined in claim 3 and further comprising

a plurality of tubular buoyancy members interconnecting at least some of adjacent ones of said plurality of transversely spanning tubular buoyancy member, said plurality of tubular buoyancy members having central longitudinal axes extending normal to and intersecting the longitudinal axes of said transversely spanning tubular buoyancy members; and

means connected to each of said plurality of interconnecting tubular buoyancy members for controlling the buoyancy thereof.

5. An offshore tower transport and launch apparatus as defined in claim 4 wherein:

said means transversely interconnecting said first and second tubular buoyancy members at intervals along the lengths thereof are fashioned having progressively increasing longitudinal lengths whereby said first and second tubular buoyancy members are mutually inwardly inclined from the bifurcated tubular sections to the unitary tubular sections.

6. An offshore tower transport and launch apparatus as defined in claim 5 wherein:

each of said first and second tubular buoyancy members are provided with a plurality of transversely extending bulkheads at longitudinally spaced locations along the length thereof for facilitating the regulation of buoyancy within the transport and launch apparatus.

7. An offshore tower transport and launch apparatus comprising:

a first tubular buoyancy member including, a unitary tubular section, and a bifurcated tubular section connected to said unitary section at one end thereof;

means for releasably connecting said first tubular buoyancy member to at least one leg of an offshore tower;

a second tubular buoyancy member including, a unitary tubular section, and a bifurcated tubular section connected to said unitary section at one end thereof;

means for releasably connecting said second tubular buoyancy member to at least another leg of the offshore tower;

means transversely interconnecting said first and second tubular buoyancy members at spaced intervals along the length of said first and second tubular buoyancy sections;

a first spherical buoyancy chamber connected to a base portion of another leg of the offshore tower in

a posture substantially diametrically opposed to the bifurcated tubular section of said second tubular buoyancy member and generally above the bifurcated tubular section of said first tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture;

a second spherical buoyancy chamber connected to a base portion of at least another leg of the offshore tower in a posture substantially diametrically opposed to the bifurcated tubular section of said first tubular buoyancy member and generally above the bifurcated tubular section of said second tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture; and

means connected to at least said first and second tubular buoyancy members and said first and second spherical buoyancy chambers for operably controlling the buoyancy thereof, whereby an offshore tower may be transported to a marine site in a generally horizontal posture substantially above the surface of a body of water and launched at the preselected marine site into a generally vertical posture onto the bed of the body of water.

8. An offshore tower transport and launch apparatus as defined in claim 7 wherein said means for releasably connecting said first and second tubular buoyancy members to an offshore tower comprises at least:

pivotal connecting means extending between base portions of the offshore tower and lowermost portions of each of said bifurcated tubular sections and wherein the transport and launch apparatus further comprises;

first auxiliary tubular buoyancy means connected to the outboard side of said unitary tubular section of said first tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus; and

second auxiliary tubular buoyancy means connected to the outboard side of said unitary tubular section of said second tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus.

9. An offshore tower transport and launch apparatus as defined in claim 8 wherein said transversely interconnecting means comprise:

a plurality of tubular buoyancy members transversely spanning between said first and second tubular buoyancy members at selected locations along the length thereof; and

means connected to each of said transverse tubular buoyancy members for controlling the buoyancy thereof.

10. An offshore tower transport and launch apparatus as defined in claim 9 and further comprising

a plurality of tubular buoyancy members interconnecting at least some of adjacent ones of said plurality of transversely spanning tubular buoyancy member, said plurality of tubular buoyancy members having central longitudinal axes extending normal to and intersecting the longitudinal axes of said transversely spanning tubular buoyancy members; and

means connected to each of said plurality of interconnecting tubular buoyancy members for controlling the buoyancy thereof.

11. An offshore tower transport and launch apparatus comprising:
 a first tubular buoyancy member;
 means for releasably connecting said first tubular buoyancy member to at least one leg of an offshore tower;
 a second tubular buoyancy member;
 means for releasably connecting said second tubular buoyancy member to at least another leg of the offshore tower;
 means transversely interconnecting said first and second tubular buoyancy members at spaced intervals along the length of said first and second tubular buoyancy sections;
 first auxiliary tubular buoyancy means connected to the outboard side of said first tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus;
 second auxiliary tubular buoyancy means connected to the outboard side of said second tubular buoyancy member for augmenting the buoyancy and stability of the transport and launch apparatus;
 a first spherical buoyancy chamber connected to a base portion of another leg of the offshore tower in a posture substantially diametrically opposed to said second tubular buoyancy member and generally above said first tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture;
 a second spherical buoyancy chamber connected to a base portion of at least another leg of the offshore tower in a posture substantially diametrically opposed to said first tubular buoyancy member and generally above said second tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture; and
 means connected to at least said first and second tubular buoyancy members said first and second auxiliary tubular buoyancy members and said first and second spherical chambers for operably controlling the buoyancy thereof, whereby an offshore tower may be transported to a marine site in a generally horizontal posture substantially above the surface of a body of water and launched at the preselected marine site into a generally vertical posture onto the bed of the body of water.
12. An offshore tower transport and launch apparatus as defined in claim 11 wherein said means for releasably connecting said first and second tubular buoyancy members to an offshore tower comprises at least: pivotal connecting means extending between base portions of the offshore tower and lowermost portions of each of said tubular sections.
13. An offshore tower transport and launch apparatus as defined in claim 12 wherein said transversely interconnecting means comprise:
 a plurality of tubular buoyancy members transversely spanning between said first and second tubular buoyancy members at selected locations along the length thereof; and
 means connected to each of said transverse tubular buoyancy members for controlling the buoyancy thereof.
14. An offshore tower transport and launch apparatus as defined in claim 13 and further comprising
 a plurality of tubular buoyancy members interconnecting at least some of adjacent ones of said plu-

- ality of transversely spanning tubular buoyancy members, said plurality of tubular buoyancy members having central longitudinal axes extending normal to and intersecting the longitudinal axes of said transversely spanning tubular buoyancy members; and
 means connected to each of said plurality of interconnecting tubular buoyancy members for controlling the buoyancy thereof.
15. An offshore tower transport and launch apparatus as defined in claim 14 wherein:
 said means transversely interconnecting said first and second tubular buoyancy members at intervals along the lengths thereof are fashioned having progressively increasing longitudinal lengths whereby said first and second tubular buoyancy members are mutually inwardly inclined.
16. An offshore tower transport and launch apparatus as defined in claim 15 wherein:
 each of said first and second tubular buoyancy members are provided with a plurality of transversely extending bulkheads at longitudinally spaced locations along the length thereof for facilitating the regulation of buoyancy within the transport and launch apparatus.
17. An offshore tower transport and launch apparatus as defined in claim 16 where said first and second tubular buoyancy members each include:
 a unitary tubular section, and
 a bifurcated tubular section connected to said unitary section at one end thereof;
18. An offshore tower transport and launch apparatus comprising:
 a first tubular buoyancy member;
 means for releasably connecting said first tubular buoyancy member to at least one leg of an offshore tower;
 a second tubular buoyancy member;
 means for releasably connecting said second tubular buoyancy member to at least another leg of the offshore tower;
 means transversely interconnecting said first and second tubular buoyancy members at spaced intervals along the length of said first and second tubular buoyancy sections;
 a first spherical buoyancy chamber connected to a base portion of another leg of the offshore tower in a posture substantially diametrically opposed to said second tubular buoyancy member and generally above said first tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture;
 a second spherical buoyancy chamber connected to a base portion of at least another leg of the offshore tower in a posture substantially diametrically opposed to said first tubular buoyancy member and generally above said second tubular buoyancy member when the first and second tubular buoyancy members are in a horizontal posture; and
 means connected to at least said first and second tubular buoyancy members and said first and second spherical chambers for operably controlling the buoyancy thereof, whereby an offshore tower may be transported to a marine site in a generally horizontal posture substantially above the surface of a body of water and launched at the preselected ma-

rine site into a generally vertical posture onto the bed of the body of water.

19. An offshore tower transport and launch apparatus as defined in claim 18 wherein said means for releasably connecting said first and second tubular buoyancy members to an offshore tower comprises at least: pivotal connecting means extending between base portions of the offshore tower and lowermost portions of each of said tubular sections.

20. An offshore tower transport and launch apparatus as defined in claim 19 wherein said transversely interconnecting means comprises:

a plurality of tubular buoyancy members transversely spanning between said first and second tubular buoyancy members at selected locations along the length thereof; and

means connected to each of said transverse tubular buoyancy members for controlling the buoyancy thereof.

21. An offshore tower transport and launch apparatus as defined in claim 20 and further comprising:

a plurality of tubular buoyancy members interconnecting at least some of adjacent ones of said plurality of transversely spanning tubular buoyancy member, said plurality of tubular buoyancy members having central longitudinal axes extending normal to and intersecting the longitudinal axes of said transversely spanning tubular buoyancy members; and

means connected to each of said plurality of interconnecting tubular buoyancy members for controlling the buoyancy thereof.

22. An offshore tower transport and launch apparatus as defined in claim 21 wherein:

said means transversely interconnecting said first and second tubular buoyancy members at intervals along the lengths thereof are fashioned having progressively increasing longitudinal lengths whereby said first and second tubular buoyancy members are mutually inwardly inclined.

23. An offshore tower transport and launch apparatus as defined in claim 22 wherein:

each of said first and second tubular buoyancy members are provided with a plurality of transversely extending bulkheads at longitudinally spaced locations along the length thereof for facilitating the regulation of buoyancy within the transport and launch apparatus.

24. A method for transporting and launching an offshore tower comprising the steps of:

floating an offshore tower in a generally horizontal posture to a preselected offshore site resting upon a transport and launch apparatus including a first and second tubular buoyancy means connected along the lateral extent of the offshore tower, a first and second auxiliary tubular buoyancy means connected to the outboard side of the first and second tubular buoyancy means, respectively, a plurality of transversely extending tubular buoyancy members interconnecting the first and second tubular buoyancy means and a first and second spherical chamber connected to a base portion of the offshore tower in a posture opposed to the first and second tubular buoyancy means respectively;

after reaching the preselected offshore site, ballasting the first and second tubular buoyancy means and the transversely extending tubular buoyancy mem-

bers interconnecting the first and second tubular buoyancy means at the base portion of the offshore tower, and thereby

rapidly pitching the offshore tower about the first and second auxiliary tubular buoyancy means, acting as a fulcrum, until the first and second spherical chambers engage the surface of the body of water wherein tendencies of the offshore tower to roll about a central longitudinal axis thereof will be minimized;

ballasting the first and second spherical buoyancy chambers to right the offshore tower within the body of water;

lowering the righted offshore tower onto the water bed by further ballasting the first and second spherical buoyancy chambers, the first and second tubular buoyancy chambers, and the first and second auxiliary buoyancy chambers; and

removing at least the first and second tubular buoyancy means, the auxiliary buoyancy means and the interconnecting buoyancy members from the offshore tower for subsequent reuse.

25. A method for transporting and launching an offshore tower as defined in claim 24 wherein the transversely extending tubular buoyancy members at least at the base of the offshore tower are interconnected with a plurality of tubular buoyancy members having central longitudinal axes extending normal to and intersecting the longitudinal axes of the transversely extending tubular buoyancy members, and further comprising the step of:

ballasting the plurality of tubular buoyancy members interconnecting the transversely extending tubular buoyancy members simultaneously with the step of ballasting the first and second tubular buoyancy means and the transversely extending buoyancy members at the base portion of the offshore tower to further facilitate pitching of the offshore tower into the body of water while simultaneously minimizing the tendency of the tower to roll during the pitching operation.

26. A method for transporting and launching an offshore tower comprising the steps of:

floating an offshore tower in a generally horizontal posture to a preselected offshore site resting upon a transport and launch apparatus including a first and second tubular buoyancy means connected about the lateral extent of the offshore tower, a first and second auxiliary tubular buoyancy means connected to the outboard side of the first and second tubular buoyancy means, respectively, a plurality of transversely extending tubular buoyancy members interconnecting the first and second tubular buoyancy means and a first and second spherical chamber connected to a base portion of the offshore tower in a posture opposed to the first and second tubular buoyancy means respectively; after reaching the preselected offshore site, ballasting the first and second tubular members at the base portion of the offshore tower, and thereby pitching the offshore tower about the first and second auxiliary tubular buoyancy means until the first and second spherical chambers engage the surface of the body of water;

ballasting the first and second spherical buoyancy chambers to right the offshore tower within the body of water;

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lowering the righted offshore tower into the water
bed by further ballasting the first and second
spherical buoyancy chambers, the first and sec-
ond tubular buoyancy chambers, and the first
and second auxiliary buoyancy chambers; 5
releasing the first and second tubular buoyancy
means from connection along the lateral extent
of the offshore tower;
pivoting the first and second tubular buoyancy
means, the first and second auxiliary tubular 10
buoyancy means and the plurality of transversely
extending tubular buoyancy members away from
the lateral surface of the offshore tower about
pivotal connections between the first and second
tubular buoyancy means and a base portion of 15
the offshore tower; and

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completely releasing the buoyancy means from the
offshore tower at the pivotal connections and
towing the first and second tubular buoyancy
means, the first and second auxiliary tubular
buoyancy means and the plurality of transversely
extending tubular buoyancy members away from
the offshore tower for subsequent reuse.

27. A method for transporting and launching an off-
shore tower as defined in claim 26 and further compris-
ing, prior to said step of pivoting, the step of:
deballasting to a generally neutrally buoyant condi-
tion the first and second tubular buoyancy means,
the first and second auxiliary tubular buoyancy
means and the plurality of transversely extending
tubular buoyancy members.

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