Feb. 9, 1960 R. G. LE TOURNEAU 2,924,077

MOBILE SEA PLATFORM

Filed Dec. 3, 1956 4 Sheets-Sheet 1

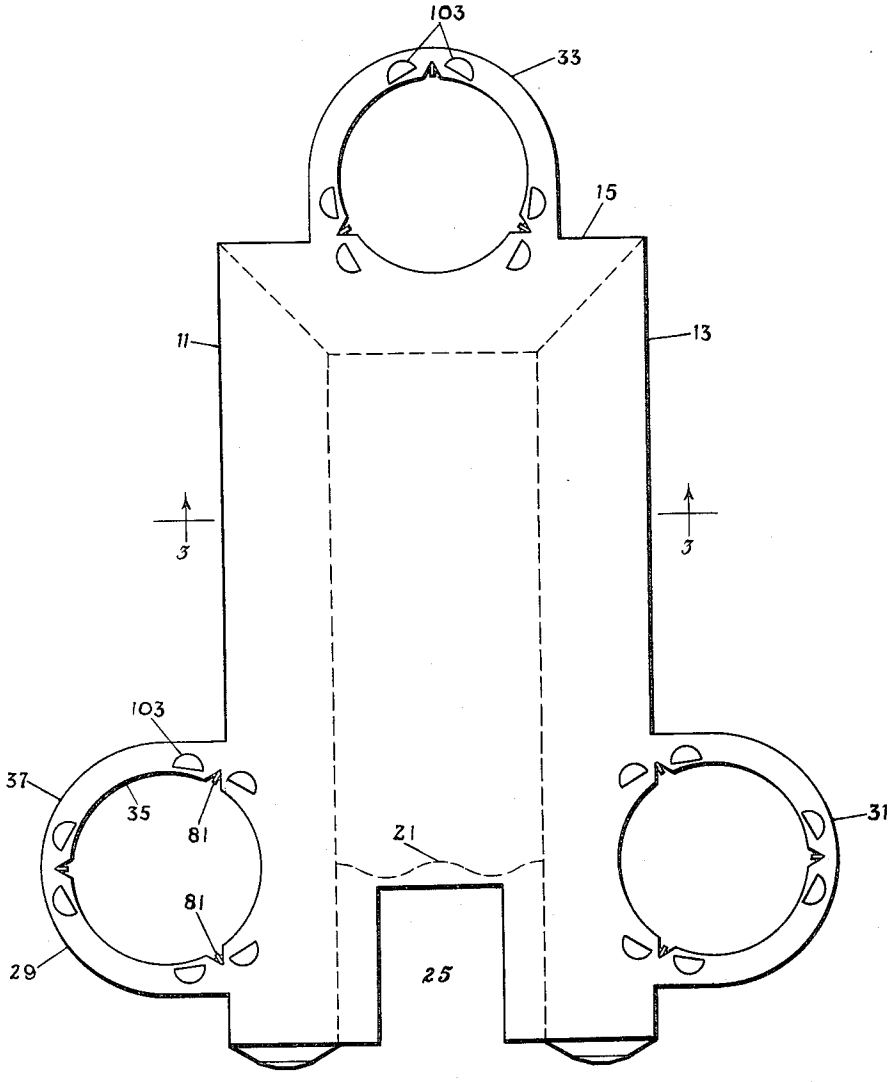

Fig. 1

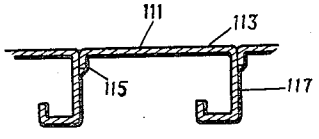

Fig. 9

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MOBILE SEA PLATFORM

Filed Dec. 3, 1956 4 Sheets-Sheet 2

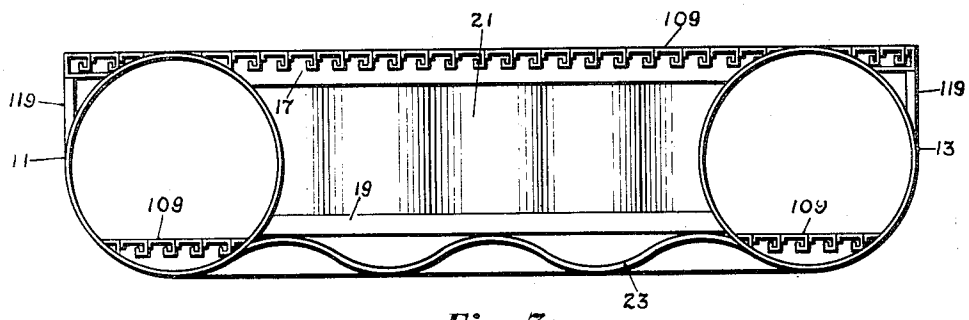

Fig. 3

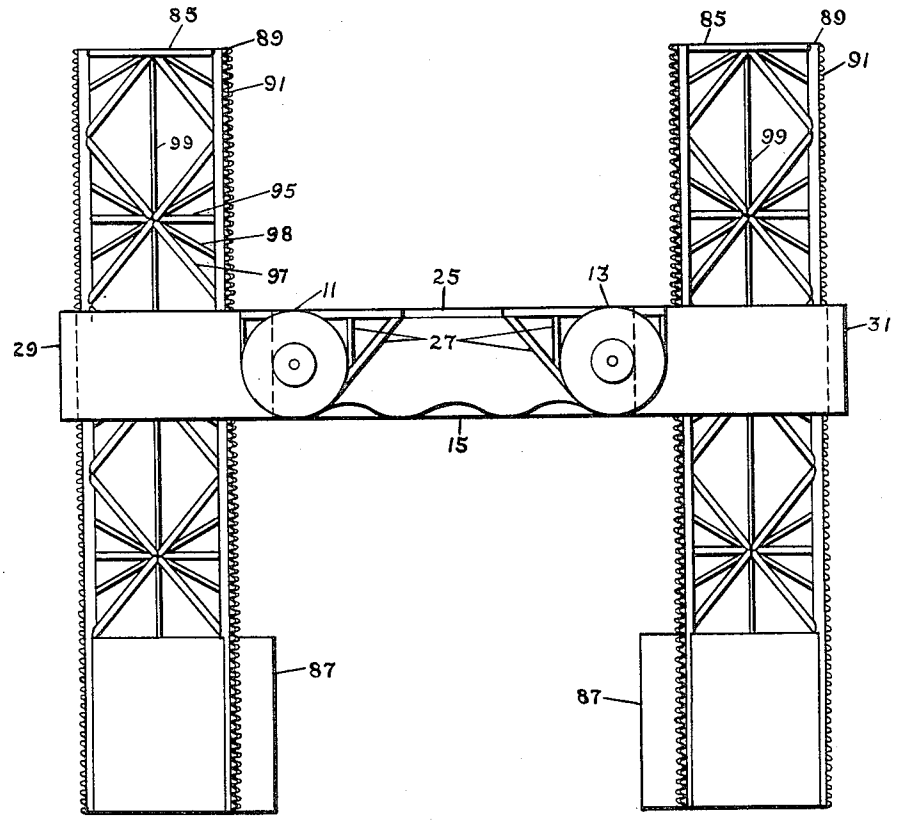

Fig. 2

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MOBILE SEA PLATFORM

Filed Dec. 3, 1956 4 Sheets-Sheet 3

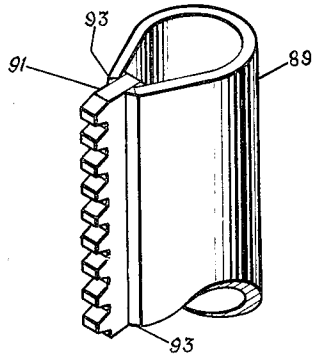

Fig. 10

Fig. 4

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MOBILE SEA PLATFORM

Filed Dec. 3, 1956 4 Sheets-Sheet 4

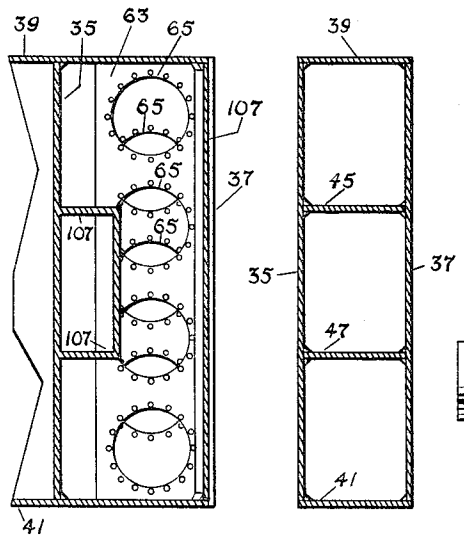

Fig. 7

Fig. 8

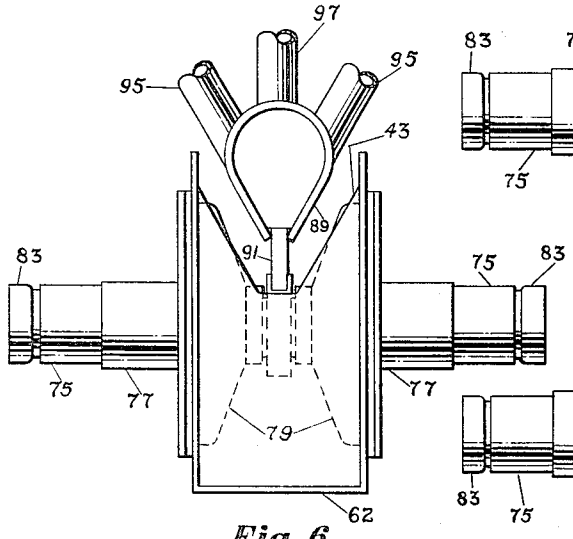

Fig. 6

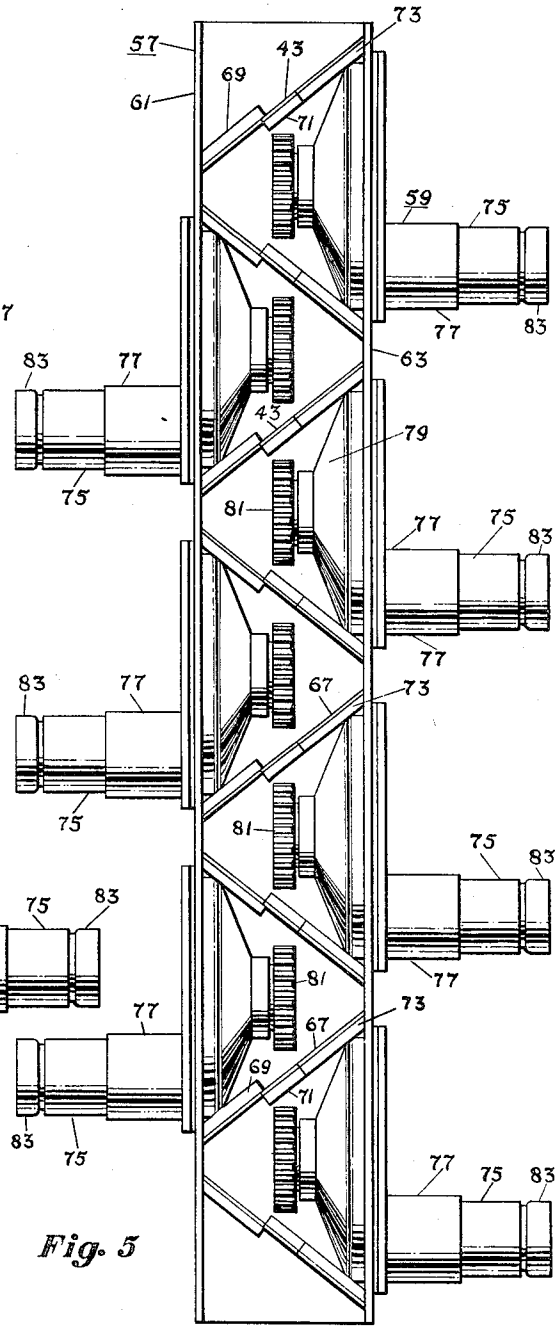

Fig. 5

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MOBILE SEA PLATFORM

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Application December 3, 1956, Serial No. 625,710

3 Claims. (Cl. 61—46.5)

My invention relates generally to improvements in mobile sea platforms, and particularly to a floatable vessels which are convertible into stabilized structures over bodies of water. My invention is especially applicable to offshore or "tidelands" oil exploration, drilling, and producing operations.

This application includes disclosure of certain improvements over the Mobile Sea Platform of my co-pending application Ser. No. 473,885, which was filed on December 8, 1954. In the co-pending application there is disclosed mobile seat platforms wherein the flotatable hull structure incorporates cylindrical members as principal hull elements, and wherein spud well structures are fixed to the outboard side of such hull members. The co-pending application further discloses spud towers, each made up of a plurality of tubular spud columns held in fixed parallel spaced relation by latticed trusswork members, with a rack carried by each spud column. Additionally the co-pending application discloses the use of a plurality of electric motor driven gear units per rack, the gear units being mounted to the spud well and each having an output pinion in driving engagement with an associated rack.

The construction of a mobile sea platform incorporating the principles and elements outlined immediately foregoing presents a number of significant problems. Among these problems is that of how to mount a plurality of rack drive units in rack engaging relation while fulfilling requirements for structural rigidity, rack and pinion alignment, space economy, maintenance accessibility, and simplicity and practicality of assembly. Another problem is that of providing a spud well structure capable of withstanding and transmitting the tremendous forces from the rack engaging pinions to the hull body, having in mind that as little as about 1% of lateral deformation in the spud well diameter would nearly disengage, and possibly jam, a pinion. A further problem is that of effectively mounting a rack on a basically tubular column without resorting to special and elaborate "build-up" between the rack and the column.

It is accordingly the broad object of my invention to provide an improved mobile sea platform of the general type disclosed in my co-pending application.

Another object of my invention is to provide effective solutions for the specific problems aforementioned.

These and other objects are effected by my invention as will be apparent from the following description taken in accordance with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a schematic plan view of the improved mobile sea platform of my invention, with the spud towers removed;

Fig. 2 is a schematic front elevational view of the platform with the rear spud tower removed;

Fig. 3 is a schematic section view taken along lines 3—3 of Fig. 1;

Fig. 4 is an enlarged schematic plan view of a spud well and spud tower, with the spud tower pontoon omitted, and with the spud well top covering removed;

Fig. 5 is a schematic front elevational view of a rack drive assembly;

Fig. 6 is an enlarged schematic plan view of a rack drive assembly engaging the rack of a spud column;

Fig. 7 is a schematic section view taken along lines 7—7 of Fig. 4, with driving units removed;

Fig. 8 is a schematic section view taken along lines 8—8 of Fig. 4;

Fig. 9 is a detailed view of decking structure; and

Fig. 10 is an enlarged schematic perspective view showing a segment of a spud tower column and rack.

Turning now to the drawings, the basic structure of the platform is shown by Figs. 1, 2, and 3. The hull comprises a pair of spaced parallel longitudinally extending cylindrical members **11**, **13** closed at their forward ends. A transversely extending cylindrical member **15** is disposed between the longitudinally extending members at their rear end portions. The rear ends of the longitudinally extending members **11**, **13** and the ends of the transversely extending member **15** are shaped to match, and corresponding ends are welded together to form a generally U-shaped water-tight unitary structure. The longitudinally extending hull members are held in rigid spaced relation by a plurality of top and bottom cross beams **17**, **19** (Fig. 3) located at intervals along the length of the longitudinally extending cylindrical members. Additional rigidity for the structure is obtained by use of a plurality of vertical corrugated bulkheads **21** each extending between the parallel spaced cylindrical members transversely thereof, and at spaced intervals along the length of said members. The hull bottom **23** is made up of longitudinally extending corrugations formed by welding steel plates and joined to the bottom portions of the cylindrical members to form a water-tight structure. The hull front end wall is disposed between the parallel spaced cylindrical members some distance from the front ends of said members as indicated at **21** in Fig. 1. The hull deck is slotted at its front end portion, with the slotted portion **25**, being adapted for receiving a derrick (not shown). The deck at the sides of the slot is supported by suitable bracing members **27**. The vessel hull carries three spud wells **29**, **31**, **33**. The two forward spud wells **29**, **31** are aligned transversely of the hull structure near its forward end, each being fixed to the outboard side of a respective longitudinally extending cylindrical hull member **11**, **13**. The rear spud well **33** is centered on the rear cylindrical member **15** and fixed to the outboard side of same. Each spud well is made up of pieces of heavy steel plates formed and welded together to make a unitary structure. The inner wall **35** of the spud well is cylindrical in shape. The spud well outer wall **37** is parallel to and spaced outwardly from the inner wall to the diameter of the inner wall which is parallel to the longitudinal axis of the cylindrical hull member to which it is fixed and then extending to said member in a plane perpendicular to said axis. The spud well has a top **39** and a bottom **41** made of steel plate material bridging between the inner and outer walls, and has also two intermediate walls **45**, **47** parallel to the top and bottom and dividing the well structure into three horizontal compartments, as shown by Fig. 8. The marginal edges of the ends of the spud well outer wall are shaped to conform to the contour of the cylindrical hull member and are welded thereto. A portion **49** of the outboard side of the cylindrical hull member, conforming to the shape of the spud well inner wall, is cut away, so that said inner wall **35** fits into the cut away portion and is welded thereto.

Each spud well carries three rack drive assemblies,

51, 53, 55 details of which are shown by Figs. 5, 6, and 7. Each rack drive assembly comprises a gear case 57 which mounts a plurality of drive units 59. The gear case is a rigid unitary structure comprising a pair of spaced parallel side walls 61, 63 made of heavy steel plate material, and an end wall 62. One side wall carries three large bolt rings 65, while the other side wall carries four large bolt rings 65. When the gear case side walls are assembled, the bolt rings are staggered so that the central axis of any bolt ring 65 is spaced equally from the central axes of adjacent bolt rings. The gear case side walls are held in rigid spaced relation by partition members 67. Each partition member is a substantially rectangular steel plate the marginal edges on three sides of which abut and are welded to gear case side walls 61, 63 and end wall 62. The fourth side of each partition member is slotted as shown at 43 in Fig. 6 to expose the drive unit rack engaging pinions 81 so that they may receive the rack 91. Alternate partition members 67 are mutually parallel, while adjacent partition members form the sides of frustro-isosceles triangles, the base of which spans a bolt ring, 65 with the base perpendicular bisector coinciding with the bolt ring central axis. Reinforcing bars 69, 71, 73 are welded to each partition member, one adjacent each side of the slot 43 and one adjacent the bottom of the slot. The lines of intersection of the partition members with the gear case side walls are mutually parallel and are perpendicular to the longitudinal axis of the side walls.

There are three gear case assemblies 51, 53, 55 disposed in each spud well 29, 31, 33. Each gear case 57 is incorporated into the spud well structure in upright position between the spud well inner 35 and outer 37 walls, with the gear case side walls 61, 63 being welded to the spud well inner wall 35, the spud well top and bottom 39, 41, and the spud well intermediate partitions 45, 47. The gear cases 57 are spaced 120 degrees apart, and so that a respective vertical plane passing through the spud well center is parallel to and equally spaced from the side walls of a respective gear case with the slots 43 in gear case partition members facing the spud well center, and one of said planes being perpendicular to the longitudinal axis of a cylindrical hull member 11, 13 to which the spud well is fixed.

Each drive unit comprises an electric motor 75 fixed in driving relation to a primary gear box which is in turn fixed to an output gear box 79. Each electric motor 75 is equipped with an electromagnetic brake 83, which is automatically engaged when the motor is de-energized. Each output gear box 79 is generally dish-shaped and carries a bolt flange 80 at its large peripheral portion, which bolt flanges is matched to the corresponding gear case bolt ring 65. Thus each drive unit 59 is an integral assembly which is bolted to a respective gear case bolt ring 65. Each output gear box 79 carries a rack drive pinion 81 which is disposed on the output gear box central axis at the gear box small end portion.

Each spud well 29, 31, 33 is of course designed to receive a spud tower 85. The spud towers are of triangular transverse cross section and each comprises three spud columns 89 at the triangle vertices and held in rigid spaced parallel relation by tubular latticed truss-work members 95, 97, 98. At spaced intervals along the spud column length there is a tubular truss member 95 disposed between each pair of adjacent spud columns 89 and lying in a horizontal plane. Additional sets of truss members extend at various spud tower levels from adjacent spud columns both upwardly and downwardly to converge at the midpoints of respective horizontal truss-members 95. Additional truss-members 97, 98 extend from the spud columns 89 and from the midpoints of the horizontal truss members 95 to converge at the intersection of perpendicular bisectors of the spud tower triangle to support a jetting conduit 99. Each spud tower carries a water-tight cylindrical pontoon tank 87 at its

lower end. Each pontoon tank is provided with a sea cock (not shown) for flooding and draining purposes. The jetting conduit 99 extends down through the pontoon tank and is for the conventional well known purpose.

Each spud column 89 is a basically tubular member having a generally "tear drop" transverse cross section as shown by Fig. 10 with a slit formed along the length of the column at the small end of the "tear drop." The "tear drop" tubular member is formed by bending a strip of heavy steel plate material to the tear-drop shape. A gear rack 91 is received in the slit and aligned to be centrally disposed in a plane passing through the longitudinal axis of the column. The rack 91 is welded on each side as at 93 to the respective column 89. The spud towers 85 are so dimensioned that the racks 91 properly engage respective sets of drive unit output pinions 81. Suitable guides (not shown) are provided to prevent excessive sideways displacement of the racks 91 with respect to the drive pinions 81.

The spud well intermediate partition walls 45, 47 are cut back in the areas adjacent the gear cases 57 to provide access wells 101 as indicated by Figs. 4 and 7. On the sides of the two gear cases adjacent the hull, the hull cylindrical member is cut away to provide access wells. A vertical spud well support plate 105 extends from the hull cylindrical member and perpendicular to its longitudinal axis to the spud well inner wall 35, and serves also as one wall of the access well in the case of the gear cases adjacent the hull. A hinged cover plate 103 is provided for each gear case access well 101 just above the hull deck level.

The hull decking, or floors, are made up of beams 111 fomred from strips of the steel plate material. The transverse cross section of a decking beam is shown by Fig. 9, and includes a surface portion 113, a downwardly extending short flange 115 on one side of the surface portion, and a generally block J shaped flange 117 depending from the other side of the surface portion 113. The decking beams are joined at their longitudinal edges by welding, with the outer surface of the short flange 115 of one beam bearing against the outer surface of the upper portion J shaped flange 117 of the adjacent decking beam, with the surface portions 113 of the decking beams lying generally in a common plane.

The manner of operation, and the electrical system of the mobile sea platform herein described is essentially the same as that of the platform disclosed by my copending application aforementioned. It will be apparent from the foregoing that I have provided effective solutions for a number of serious problems in mobile sea platform design and construction. The concept of building the large gear cases as integral units and then incorporating them into the spud well structure, with a plurality of individual power units removably fixed to each gear case, is an effective solution to one serious problem. The spud tower column structure disclosed herein results in a basically tubular column and yet provides surfaces for receiving the racks so that welding is convenient and no special "build-up" is required. The spud well structure disclosed herein is remarkably simple and yet has amazing structural quality.

While I have shown my invention in only one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

I claim:

1. In a vessel convertible into a stabilized structure over a body of water and of a type wherein the vessel may be raised or lowered on spud towers having racks engaged by pinions driven by electric motors, a driving assembly for each rack comprising a unitary gear case fixed rigidly to the vessel and having parallel spaced side walls, a plurality of bolt rings integral with one side wall and each surrounding a separate opening in said wall, a plurality of bolt rings integral with the other

side wall and surrounding openings therein which are staggered with respect to the openings in the opposite side wall, each said bolt ring adapted to receive a drive unit comprising an electric motor driven gear box having an output pinion with the output pinions of all of said drive units being aligned, and an opening in one face of said gear case for receiving a rack, with all of said pinions engaging said rack.

2. In a vessel convertible into a stabilized structure over a body of water and of a type having a hull comprising a cylindrical main member, with a spud well carried by said member, with a spud tower in said well and having rack mounting tower columns with the rack in each case engaging pinions of drive units carried in said well; a spud well structure comprising a circular inner wall, an outer wall spaced outwardly from said inner wall, said outer wall having a first portion which is parallel to the outermost half of said inner wall and second and third portions which extend from the respective ends of said first portion to said member in respective planes which are perpendicular to the central axis of said member a top and bottom bridging between said walls, intermediate walls parallel to said top and bottom walls and dividing said well into horizontal compartments, a unitary gear case adjacent each rack mounting tower column and having side walls adapted for receiving a plurality of drive units, said gear case side walls being fixed to said inner spud well wall and parallel

to a vertical plane passing through a diameter of said inner wall and midway between said gear case side walls.

3. In a vessel convertible into a stabilized structure over a body of water and of a type wherein the vessel may be raised or lowered on spud towers having racks engaged by pinions driven by electric motors, a driving assembly for each rack comprising a unitary gear case incorporated into the vessel structure, said gear case having a pair of spaced side walls and an open side, each side wall having a plurality of spaced openings therein each surrounded by a bolt ring, a plurality of drive units each comprising an electric motor driven gear box having an output pinion, one of said drive units being removably received by each said bolt ring with all of said output pinions extending within said gear case and vertically aligned, each of the racks extending into a corresponding one of said gear cases thru the open side thereof, with all of said pinions engaging said rack.

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