

Jan. 23, 1968

W. A. SANDBERG

3,364,684

DEEP WATER OFFSHORE DRILLING PLATFORM

Filed Oct. 1, 1965

4 Sheets-Sheet 1

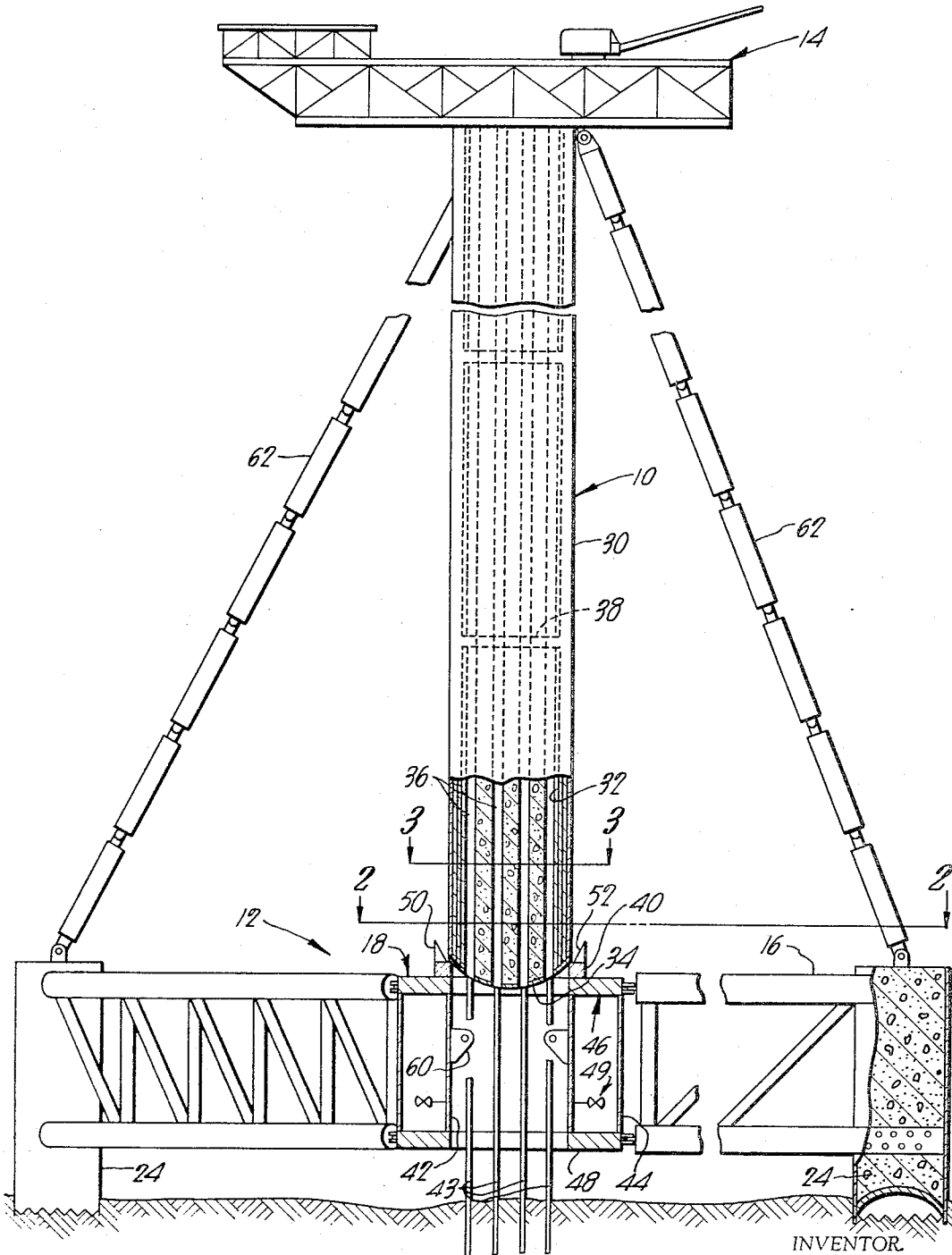


FIG 1

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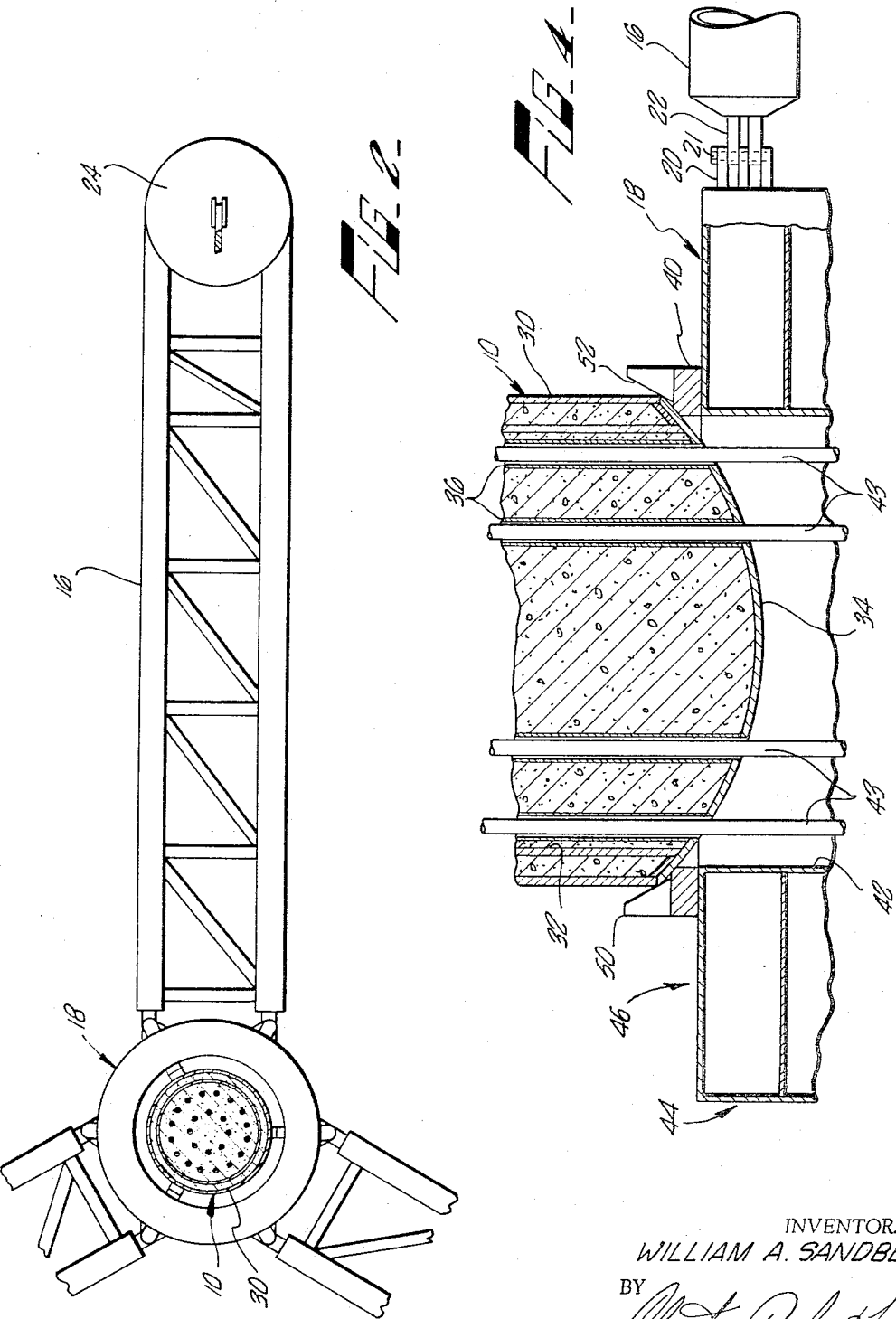
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4 Sheets-Sheet 3

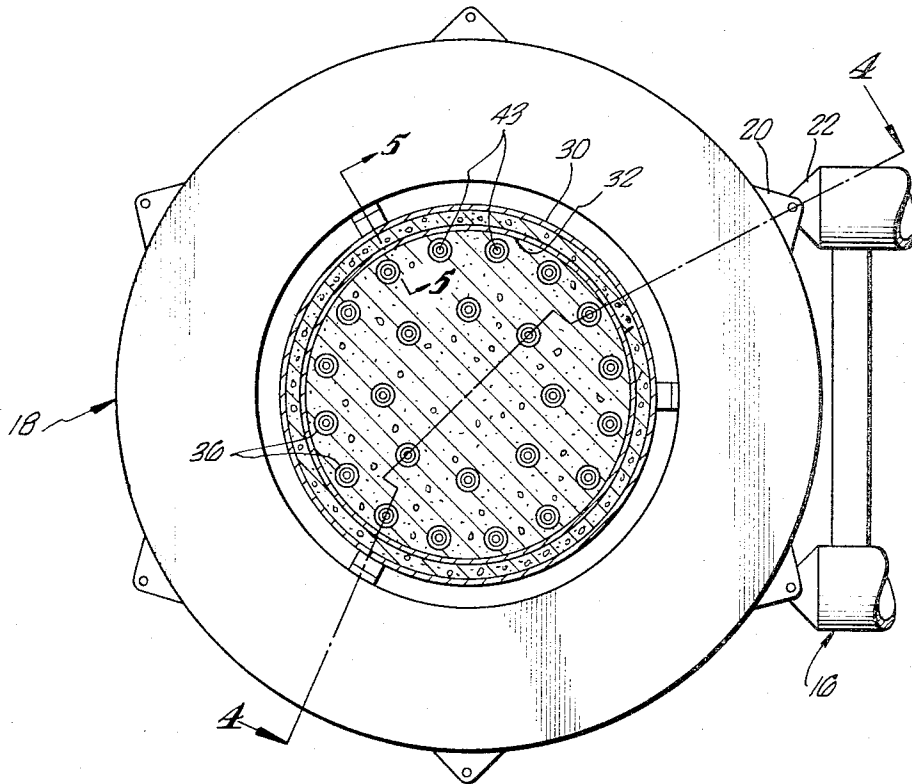


FIG. 3

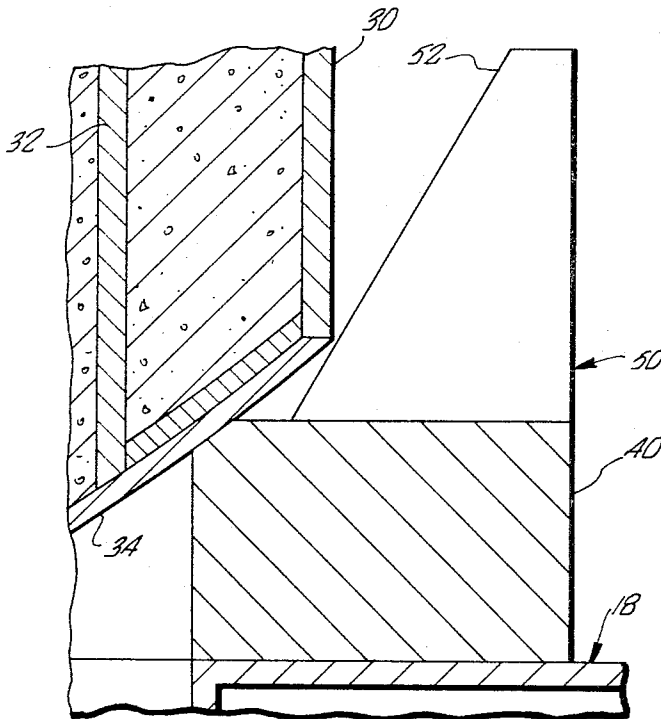


FIG. 5

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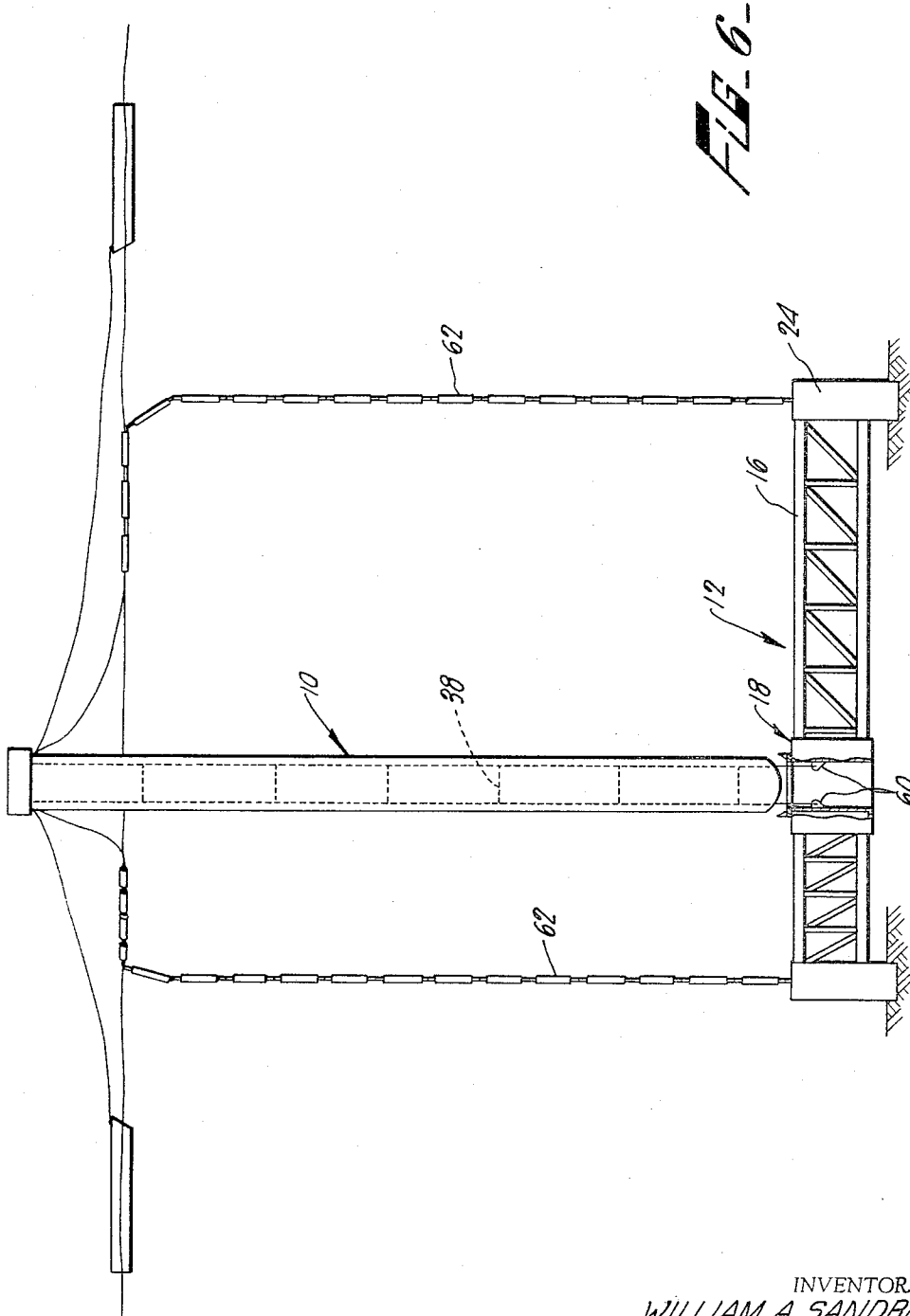
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DEEP WATER OFFSHORE DRILLING PLATFORM

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4 Sheets-Sheet 4



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DEEP WATER OFFSHORE DRILLING PLATFORM

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2 Claims. (Cl. 61-46)

ABSTRACT OF THE DISCLOSURE

There is shown an offshore drilling platform in which a vertical caisson or column is supported on the ocean floor and held vertically against lateral forces by a tripod base having a plurality of radial arms extending from a cylindrical hub. The outer ends of the arms are supported on the ocean floor and are attached by tension members to the upper end of the column. The top of the cylindrical hub engages the bottom of the caisson so that the caisson resists any tilting action of the base due to lateral forces on the caisson.

This invention relates to drilling platforms for offshore drilling operations and, more particularly, is concerned with a drilling platform which can be assembled and disassembled at the drilling site.

There is a need in offshore drilling exploration for a drilling platform which can be transported in pieces and assembled at the location. One such offshore drilling platform is described in Patent 2,772,539 issued to the same inventor as the present invention.

The present invention is directed to a similar drilling platform but of improved design which permits its use in water of substantially greater depth and where the bottom terrain is more sloping. Moreover, the present improved design of drilling platforms permits twenty or more wells to be drilled from a single platform in contrast to the single well which could be drilled from the platform described in the above-identified patent.

In brief, the present invention relates to a drilling platform of the type in which a vertical caisson is supported at its lower end at the center of a tripod structure resting on the ocean floor. The caisson can be tilted in relation to the base of the tripod about its lower end to permit the caisson to be truly vertical regardless of sloping or unevenness in the ocean floor at the drilling site. The caisson is restrained against tilting or shifting under the forces of surface wave action or seismic disturbances by tension members attached to the outer extremities of the base structure and the upper end of the caisson.

The improved features of the present invention are achieved by a unique design of the engaging structure where the caisson and base of the tripod join. The base of the tripod structure is provided with an annular cylindrical hub having a large central opening only slightly smaller in diameter than the caisson. Three horizontal arms project radially outwardly from the hub and are supported at their ends from the ocean floor by vertical legs. A supporting annular plate having a beveled inner edge forming a conical surface is mounted on the top of the hub. The lower end of the caisson is convexly curved so as to rest on the conical surface of the supporting plate. The upper end of the caisson is secured by tension members or guys extending from the top end of the caisson to each of the vertical supporting legs of the base. The caisson can be tilted substantially with relation to the hub while still retaining mating contact between the supporting plate and bottom of the caisson. At the same time, the bottom of the caisson remains axially within the center of the opening in the hub. The hub is structurally

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designed to transmit forces through the arms of the tripod base to the legs resting on the ocean floor. At the same time, the opening in the hub is large enough to permit a large number of conductor tubes to extend out the bottom of the caisson into the ocean floor for slant drilling a corresponding number of wells from the single platform structure. The vertical component of force of the caisson is taken by the conductor tubes directly to the ocean floor. The vertical component of force of the guys is taken by the weighted vertical legs.

For a more complete understanding of the invention, reference should be made to the accompanying drawings wherein:

FIGURE 1 is an elevational view of the drilling platform;

FIGURE 2 is a section taken on the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged sectional view taken on the line 3—3 of FIGURE 1;

FIGURE 4 is a partial sectional view taken on the line 4—4 of FIGURE 3;

FIGURE 5 is an enlarged sectional detail taken on the line 5—5 of FIGURE 3; and

FIGURE 6 is an elevational view showing an intermediate step in the assembly of the drilling platform.

Referring to FIGURE 1, the numeral 10 indicates generally a vertical caisson which is supported by a tripod structure, including a base indicated generally at 12 resting on the ocean floor. The upper end of the caisson 10 projects above the surface of the water and supports a working platform structure indicated generally at 14, on which suitable drilling rigs (not shown) may be supported for drilling into the ocean floor.

The tripod base structure 12 is provided with three horizontally projecting arms 16 which are joined together at their inner ends by an annular hub indicated generally at 18. The arms are removably joined to the hub by pins 21 which pass through mating flange members 20 and 22 secured respectively to the outside of the hub 18 and to the inner end of the arms 16. This arrangement permits assembly of the tripod base structure at the location before it is permitted to sink to the ocean floor.

Each of the arms 16 terminates at its outer end in a leg or stanchion 24, the lower end of which is designed to impress itself into the material of the ocean floor and support the entire tripod structure in bridgelike fashion above the surface of the ocean floor. The legs are weighted by rock or concrete to anchor them in position.

The vertical caisson 10 is constructed with an outer cylindrical wall 30 and a concentric inner cylindrical wall 32 with the space between the two concentric walls filled with concrete. This provides a rigid shell which is capable of withstanding the large pressures that exist at the 600 ft. depths at which the lower end of the caisson may be exposed. The bottom 34 of the caisson forms a spherical surface of radius somewhat larger than the radius of the cylindrical caisson outer wall 30.

The caisson is provided with a plurality of guide pipes 36 which may be arranged in two concentric circles as shown in FIGURE 3. Twenty-four such guide pipes are shown by way of example of a typical installation. The guide pipes are joined to and form openings in the bottom wall 34 of the caisson and extend upwardly to the top of the caisson to form openings at the platform 14. The lower ends of the guide pipes are encased in concrete which acts as a weight at the lower end of the caisson and provides strength to the caisson structure. Watertight bulkheads are located within the inner wall 32 of the caisson at spaced points, as indicated at 38. The watertight bulkheads form compartments which can be individually flooded with sea water at the time the caisson

is caused to sink into position. The bulkheads also provide lateral support for the guide pipes 36.

The lower end of the caisson 10 engages an annular seat 40 mounted on top of the hub 18. The hub 18 is a hollow annular structure including an inner wall 42 and a concentric outer wall 44 and enclosing end walls 46 and 48. The hollow annular interior of the hub 18 is also arranged to be flooded with sea water for submerging the hub and tripod base structure at the desired location. The hub is provided with suitable valves 49 by which sea water can be admitted and compressed air can be pumped in to control the volume of air in the hub at any depth.

The seat 40 has an opening of the same diameter as the inner cylindrical wall 42 of the hub, which diameter is slightly smaller than the outer diameter of the caisson 10 but larger in diameter than the inner concentric wall 32 of the caisson 10. The upper edge of the opening in the seat 40 is beveled to provide a conical surface which engages the spherical bottom surface 34 of the caisson 10. The seat 40 is provided with at least three vertically projecting guide members 50 having slanted inner edges 52 which deflect the caisson towards axial alignment with the center of the hub 18 as the caisson is lowered into position.

FIGURE 6 shows the manner in which the caisson 10 is brought into position at the desired location. The tripod base structure is first assembled at the surface, flooded and allowed to settle to the ocean floor. Before the tripod structure 12 is allowed to sink, cables are attached to cable brackets 60 secured to the inner wall of the hub 18. These cables are threaded through a pair of the guide pipes 36 extending through the caisson 10 and brought out to barges or ships. The caisson 10 is initially horizontal and floating on the surface of the ocean. As it is flooded starting with the lowermost water compartment, the lower end of the caisson sinks until the caisson assumes a vertical position. The guide cables are then drawn taut by backing off the barges. As the flooding of the caisson continues, it is guided by the cables into seating position on the seat 40.

Once the caisson 10 is seated in a vertical position, conductor tubes 43 are inserted in the guide pipes 36 and used as piles which are driven into the ocean floor through the bottom 34 of the caisson 10 and through the central opening in the hub 18. Once the conductor tubes are anchored in the ocean floor, the conductor tubes are cemented into position within the guide pipes 36 so that the vertical load imposed on the caisson by the platform 14 and superstructure mounted on the platform is transmitted to the ocean floor through the conductor tubes. At the same time, the conductor tubes provide passages for the drill stem and the subsequent process of drilling wells into the ocean floor from the platform 14.

Three guys 62, made up of a plurality of hollow buoyant sections which are pivotally connected together at their ends, join the legs 24 of the tripod base structure 12 to the platform 14 at the top of the caisson 10. The guys are pre-stressed so that the maximum lateral forces on the caisson do not overcome the pre-stressed tension.

The above-described structure in spite of the tremendous size and height of the caisson 10, typically the caisson being 600 ft. high and 40 ft. in diameter, is capable of withstanding large lateral forces imposed by surface wave action or seismic disturbances which are transmitted to the caisson 10 by the surrounding ocean. At the same time, the vertical load of the caisson and superstructure is transmitted to the ocean floor through the pilings. The unique arrangement by which the caisson is guided and seated on the hub permits the tripod base structure to be canted with the ocean floor at a substantial angle to the horizontal. At the same time, the hub arrangement provides a sufficiently large opening that a large number of drill stem conductor tubes may be provided through the single caisson structure. This permits twenty or more wells to be drilled from a single platform by slant drilling techniques.

What is claimed is:

1. A rig for drilling a number of holes in the ocean floor from a single platform comprising a base including a hub and radial arms anchored at their outer ends to the ocean floor and rigidly secured to the hub at their inner ends, the hub having upper and lower end walls joined by inner and outer concentric cylindrical side walls, the radial arms being secured to the hub adjacent the upper and lower end walls, whereby tension and compression forces in the radial arms are transmitted between the arms through the annular end walls, a vertical column having a cylindrical outer wall and a spherical bottom, an annular seating member mounted on top of the upper end wall of the hub having an opening only slightly smaller in radius than the cylindrical wall of the column, the seating member having a conically recessed surface adapted to engage the spherical bottom of the column to permit substantial angular tilting of the column in relation to the hub, the annular end walls and cylindrical inner wall forming a single opening through the hub below the seating member, the column including a plurality of pipes through which conductor tubes extend through the column and the central opening in the hub into the ocean floor for supporting the column, and tension members extending from the upper end of the column to the outer ends of the radial arms for transmitting horizontal loads on the column to the base.

2. Apparatus as defined in claim 1 further including brackets in the opening in the hub and a cable secured to each bracket and extending through a pipe in the column to the upper end of the column at the ocean surface.

References Cited

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