

Feb. 26, 1952

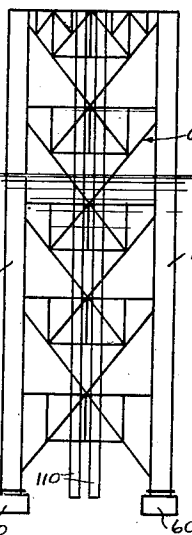
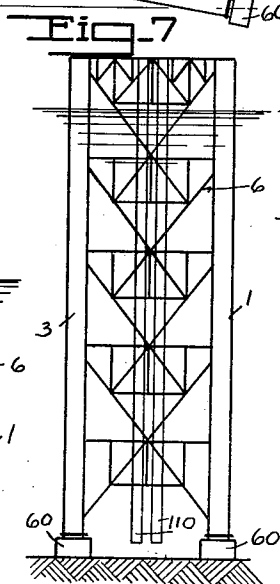
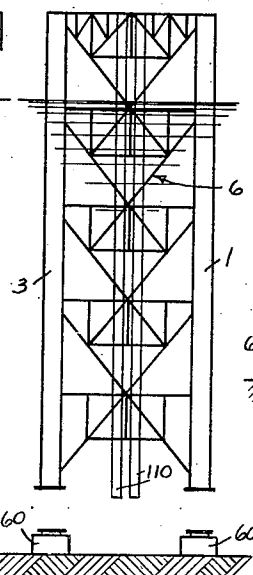
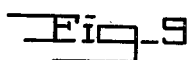
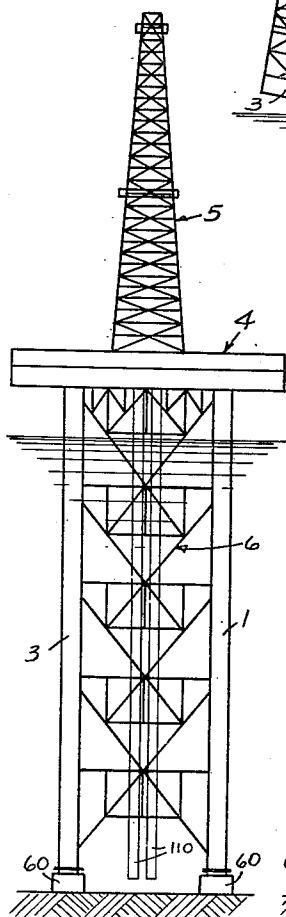
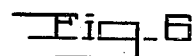
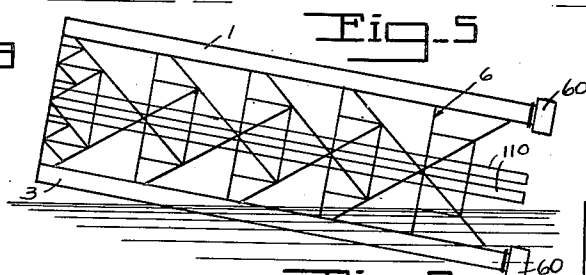
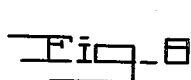
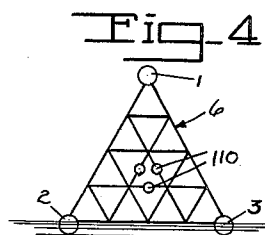
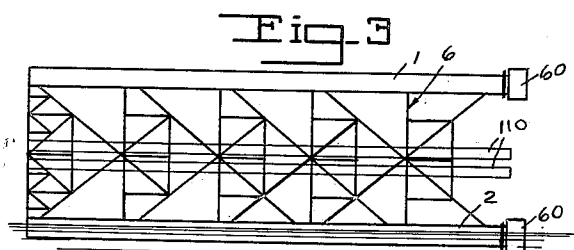
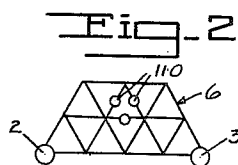
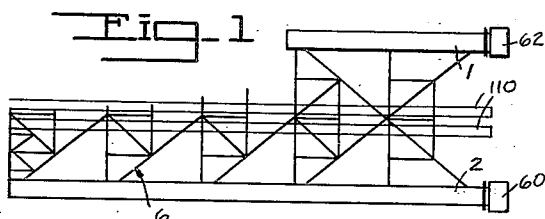
T. M. KUSS ET AL

2,586,966

DEEP WATER OIL WELL DRILLING SYSTEM

Filed Aug. 8, 1949

4 Sheets-Sheet 1



INVENTOR.
THEODORE M. KUSS,
RALPH D. RUSSELL

BY

Boyer, Mohler & Beckley.

ATTORNEYS

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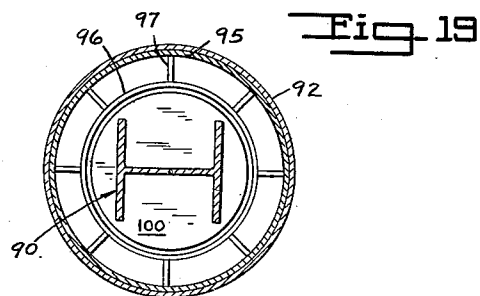
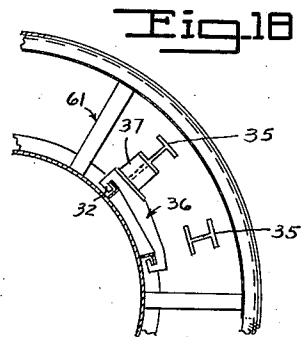
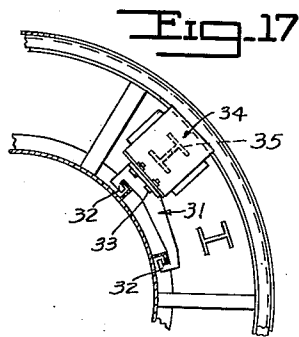
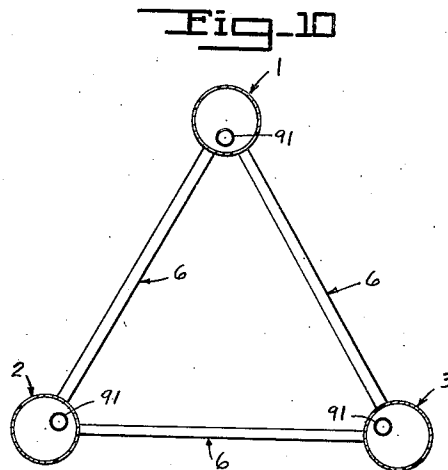
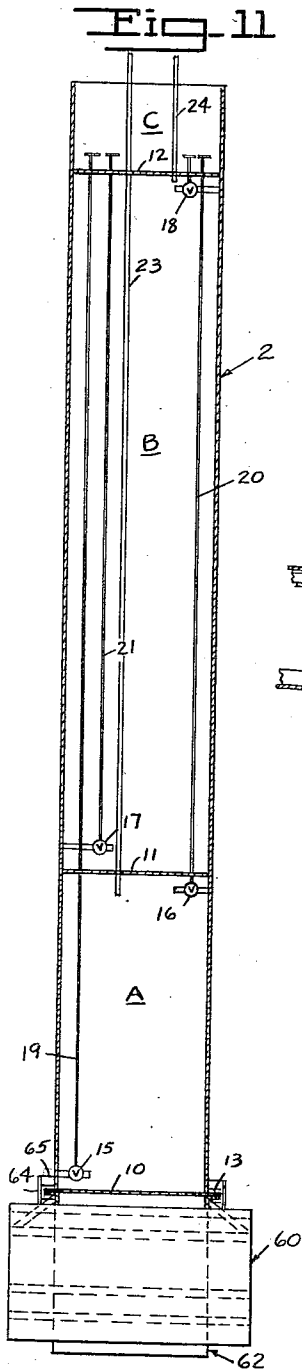
T. M. KUSS ET AL

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DEEP WATER OIL WELL DRILLING SYSTEM

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4 Sheets-Sheet 2



INVENTOR.
THEODORE M. KUSS
RALPH D. RUSSELL

BY

Boyer, Mahler & Beckley

ATTORNEYS.

Feb. 26, 1952

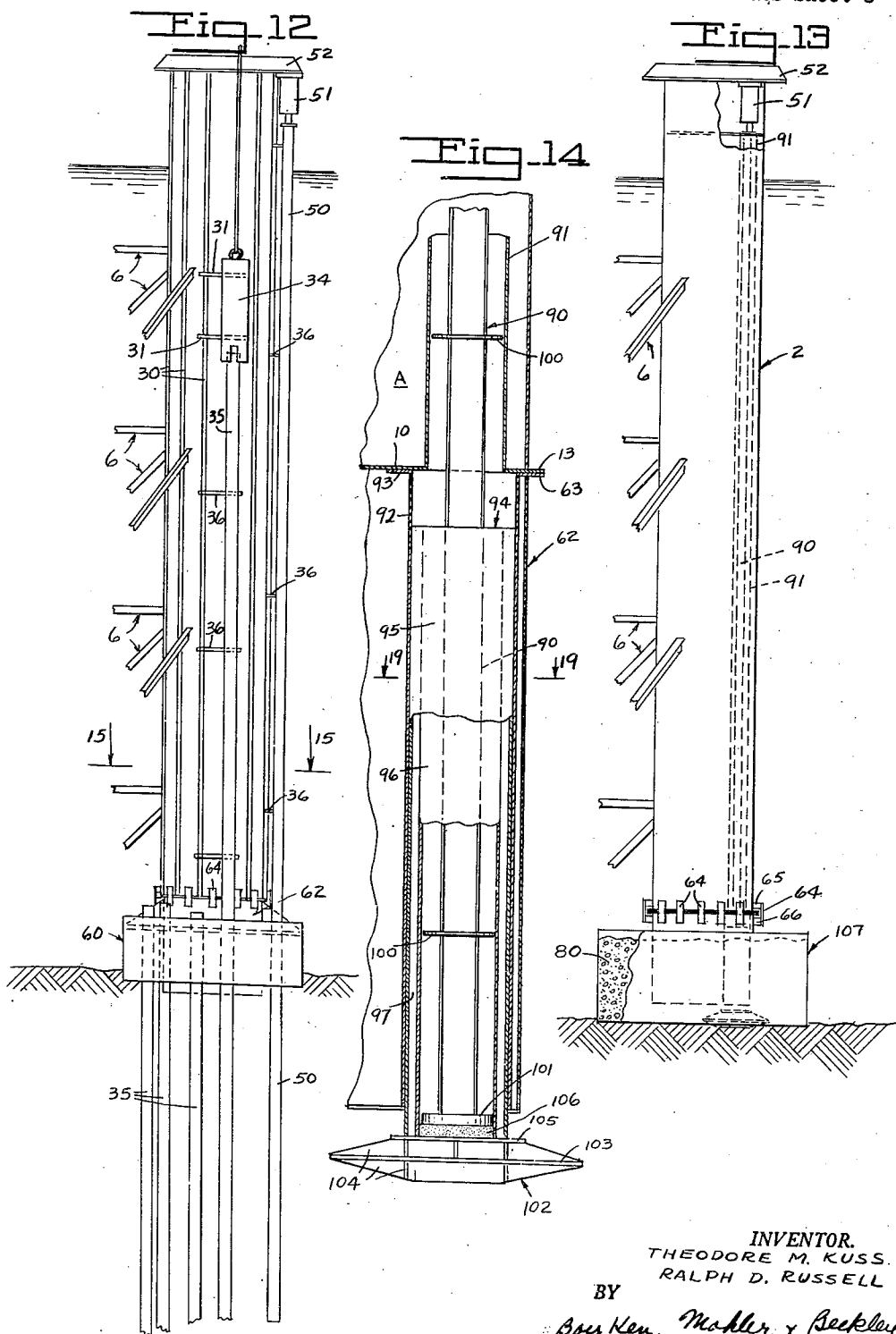
T. M. KUSS ET AL

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DEEP WATER OIL WELL DRILLING SYSTEM

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4 Sheets-Sheet 3



INVENTOR.
THEODORE M. KUSS.
RALPH D. RUSSELL

BY

Boyd Ken, Mahler & Beckley.

ATTORNEYS

Feb. 26, 1952

T. M. KUSS ET AL

2,586,966

DEEP WATER OIL WELL DRILLING SYSTEM

Filed Aug. 8, 1949

4 Sheets-Sheet 4

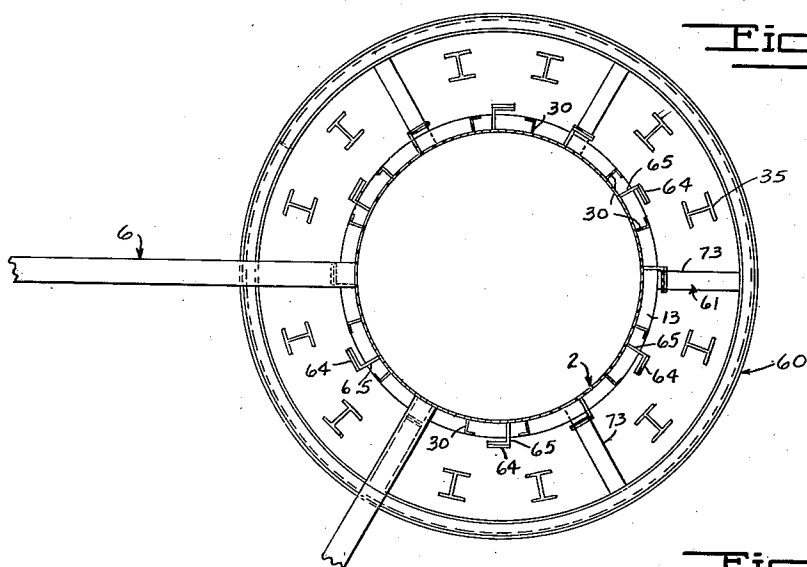


Fig. 15

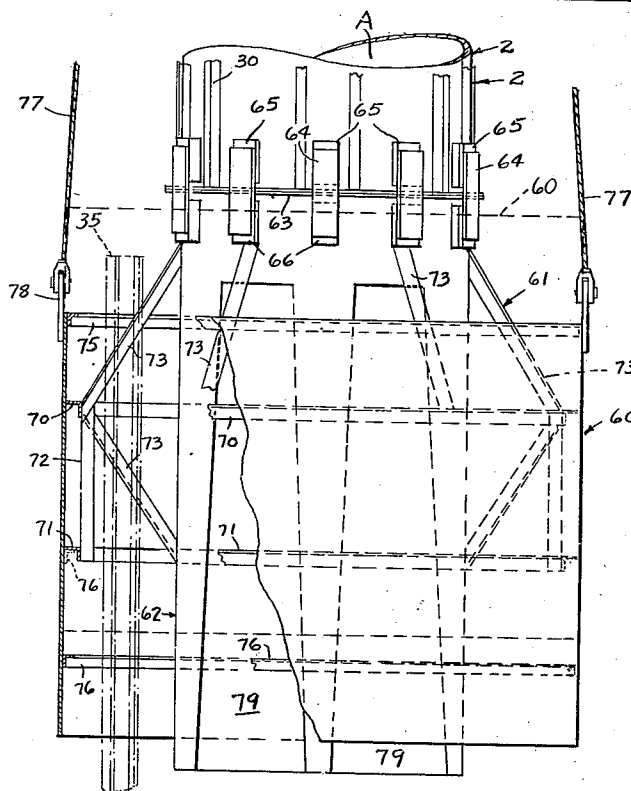


Fig. 16

INVENTOR.
THEODORE M. KUSS
RALPH D. RUSSELL

BY

Boyer, Mohler & Beckley

ATTORNEYS.

UNITED STATES PATENT OFFICE

2,586,966

DEEP WATER OIL WELL DRILLING SYSTEM

Theodore M. Kuss, San Francisco, and Ralph
Denton Russell, Oakland, Calif.

Application August 8, 1949, Serial No. 109,212

19 Claims. (Cl. 61—46)

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This invention relates to a structure which may be employed to remove oil from the soil under the ocean bed and which structure has certain similarities to that disclosed in our co-pending application, Serial No. 55,044 filed October 18, 1948.

One of the objects of this invention is the provision of a structure for oil drilling at sea which may be partially constructed on land and thereafter towed to the site at which drilling operations are to take place so that the work of assembly involved at the drilling site is a minimum.

Another object of the invention is the provision of a structure of such a shape that it may be built economically and still have the required strength to resist stresses due to floating the same on water and those due to erection of the structure under water.

Still another object of the invention is the provision of a structure for oil drilling at sea which permits the floating of such structure out to sea without creating excessive drafts.

And yet another object of the invention is the provision of means for adequately anchoring such an oil drilling structure at sea so that the same may resist natural forces of wind, waves and earthquake without undue movement.

Other objects and advantages will be apparent from the specification and the drawings wherein: Fig. 1 is a schematic side elevational view of the caisson structure partially completed on a building ways.

Fig. 2 is a schematic end elevational view of the structure shown in Fig. 1.

Fig. 3 is a schematic side elevational view of the caisson portion of the structure being floated to the oil drilling site.

Fig. 4 is a schematic end elevational view of the water borne structure shown in Fig. 3.

Fig. 5 is a schematic side elevational view of the caisson of Fig. 3 when the same is partially up-ended by admission of water into two of the tubular legs.

Fig. 6 is a schematic side elevational view of the caisson of Fig. 3 after the same has been brought to a vertical position by admission of water into the legs.

Fig. 7 is a schematic side elevational view of the caisson of Fig. 6 resting on the ocean bed.

Fig. 8 is a schematic side elevational view of the completed structure including decks employed for supporting the derrick and other well drilling structure.

Fig. 9 is a side elevational view of the structure

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after the same has been detached from its base preparatory to towing the structure to another site.

Fig. 10 is a cross-sectional view through the caisson showing the position of the spud tubes in the caisson legs when the structure is employed on a relatively hard ocean bed.

Fig. 11 is a schematic cross-sectional view of one leg of the caisson showing the watertight partitions and means for flooding the watertight cells within the legs.

Fig. 12 is an enlarged elevational view of one leg only of the caisson showing the means employed for anchoring the same on a relatively soft ocean bed.

Fig. 13 is an enlarged elevational view of one leg only of the structure showing the means employed for anchoring the same on a relatively hard ocean bed.

Fig. 14 is a greatly enlarged cross-sectional view through a portion of the leg shown in Fig. 13 illustrating the means for leveling the structure when the ocean bed is irregular.

Fig. 15 is a greatly enlarged transverse cross-sectional view through one leg of the structure as taken along lines 15—15 of Fig. 12.

Fig. 16 is a greatly enlarged side elevational view partly broken away and in section of the base portion of the leg shown in Fig. 12.

Fig. 17 is a fragmentary cross-sectional view of a portion of the leg of Fig. 12 showing the means employed for guiding the pile driver.

Fig. 18 is a fragmentary cross-sectional view of a portion of the leg of Fig. 12 showing the means employed for guiding the piling.

Fig. 19 is an enlarged cross-sectional view through the spud and spud guide as taken along lines 19—19 of Fig. 14.

The invention comprises a generally elongated caisson having three legs which are adapted to extend between the bed and the surface of the ocean or other body of water. These legs are generally designated at 1, 2 and 3 in the drawings and are preferably fabricated of steel and made watertight. Upon installation of the caisson with the legs 1, 2 and 3 disposed vertically and with their lower ends on the bed of the ocean a deck or superstructure generally designated 4 (Fig. 8) may be erected on the upper ends of the legs 1, 2 and 3 by any approved manner such as welding or riveting. This deck 4 is of such form and strength as to support an oil drilling derrick 5 (Fig. 8) and other oil drilling equipment such as engines, fresh water

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tanks, compressors, generators which are required in conventional oil drilling installations.

The legs 1, 2 and 3 are hollow and cylindrical and are identical in all respects. These legs may be integrally secured together by bracing and frames generally designated 6 in the drawings. It is preferable that the caisson be generally triangular in cross-section (Figs. 4 and 10) with one of the legs positioned at each apex of the triangle. This shape is an important feature of the invention for reasons which will be described subsequently in greater detail.

Referring to Figs. 1 and 2 it is seen that the caisson may be fabricated on a building ways such as that from which ships are normally launched. Legs 2 and 3 may be disposed in a horizontal plane and integrally connected by suitable bracing 6 as shown in Fig. 2 and then the leg 1 may be erected upon similar bracing (Fig. 4) in any approved manner. Upon launching the caisson the buoyancy of the hollow legs 2, 3 will be sufficient to support the leg 1 and most of the caisson structure out of the water. The method of closing the ends of the legs to provide a watertight structure will be explained subsequently in detail. It will be noted that the caisson when waterborne is an exceedingly stable structure and one which may be readily towed to the drilling site without possibility of capsizing.

Referring to Fig. 11 wherein certain ballast control means are shown schematically in one leg 2 of the caisson, it is seen that each of the tubular legs 1, 2 and 3 is provided with a transverse watertight bulkhead 10 at the lower end of the leg. This bulkhead 10 is preferably larger in diameter than the leg to provide an annular flange 13 around the periphery of the leg adjacent its lower end.

Intermediate the ends of the legs 1, 2 and 3, but preferably somewhat closer to the bottom than the top, is a transverse watertight bulkhead 11 which creates a watertight compartment or cell A adjacent the lower end of each leg.

Adjacent the upper end of each of the legs 1, 2 and 3 is a watertight bulkhead 12 which is preferably spaced from the upper end of the tubular leg to provide a working space C for operators. This bulkhead 12 and the intermediate bulkhead 11 define a watertight compartment or cell B (Fig. 11).

A flooding valve 15 is provided adjacent the lower end of cell A to admit water into the cell A upon operation of control rod 19 from the top of the caisson. To permit escape of air from cell A a relief valve 16 is provided adjacent the upper end of the cell which may be remotely controlled by control rod 20.

In a similar manner, cell B is provided with flooding and vent valves 17 and 18 respectively which in turn may be operated by control rods 21 and 22 from the top of the caisson.

It will be apparent from Figs. 3-6 that the caisson may be swung from its horizontal floating position of Figs. 3 and 4 to the position of Fig. 5 by the opening of valves 15 and 16 in legs 2 and 3. To retain maximum possible control over the structure it is important that the above valves in legs 2 and 3 be opened concurrently so that the structure does not tend to tilt transversely of its length during submergence. If the loss of buoyancy due to flooding cell A is not sufficient to bring the lower end of leg 1 into the water additional selective flooding of cell B may be resorted to by operation of valves 17 and 18.

If the valves 15 and 16 of leg 1 are open when

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the lower end of leg 1 starts to submerge the swinging of the structure will continue until the upright position shown in Fig. 6 is achieved. At this point, the caisson may be brought to a vertical position by selective flooding of cell B in any of the legs 1, 2 and 3.

It is important to note in this connection that the structure is constantly in a condition of stable equilibrium during the above processes due to the triangular arrangement of the three legs. It will be apparent that a four-legged structure for example would not lend itself to accurate control during the above described operations because unstable conditions might be created which would not be visibly apparent during the submergence of the structure. If, for example, in a four legged structure two diagonally opposite legs only were flooded when the caisson is in the position of Fig. 6, submergence might continue but the structure would be unstable and a sudden swinging about a horizontal axis might ensue thereby setting up undesirable stresses in the caisson and creating dangerous conditions.

Upon continued flooding of the cells B the caisson may be submerged as slowly as desired until the caisson is supported at its lower end on the bottom. (In the event that the ocean bed is irregular, additional means will be required to level the structure and such means will be subsequently described.)

As will be subsequently described in detail, a substantial portion of the caisson is adapted to be removed after the oil drilling operation has been performed. The portion which may be removed contains the cells A, B and C and may be thereafter employed at another site if desired. For raising the caisson, air lines 23 and 24 may be employed for removing the water from cells A and B. Air line 23 communicates between cell C and cell A and may extend to a compressor on a barge (not shown) or on the structure itself for the purpose of forcing the water from cell A after valve 15 has been opened. In like manner air line 24 communicating between cells C and B may be employed to blow cell B. Upon raising the structure for refloating, the water in cell B is preferably removed first so that the structure is relatively stable during the refloating operation.

The methods hereinafter described for anchoring the caisson to the bed of the ocean will be generally divided into two distinct processes depending on the characteristics of the ocean bed at the site. If the bed is level little difficulty is encountered. If the bed is irregular and relatively soft the caisson may be leveled to a certain extent by increasing the amount of water admitted to the legs on the high side, thus causing one or two of the legs to sink further into the mud than the leg or legs resting on the lower side. If varying the amount of water ballast does not permit bringing the caisson to a vertical position additional levelling means are employed which will now be described in connection with the method of anchoring the caisson.

Levelling and anchoring means for soft beds

Figs. 12, 15 and 16 illustrate the method employed for anchoring the caisson on a relatively soft ocean bed and at the same time insuring that the caisson will be disposed vertically before the deck and derrick construction is commenced. An annular row of longitudinally extending angle bars 30 are rigidly secured to the periphery of each of the tubular legs 1, 2 and 3 (Fig. 15). These angles 30 stiffen the legs and

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also serve as guides for the piles and the pile driver employed to anchor the caisson on the ocean bed. The angles 30 are arranged in pairs with the free flanges of the angles of each pair directed away from each other as shown in Fig. 15. Referring to Fig. 17 it is seen that generally elongated yokes 31 are adapted to be slidably secured at its ends to a pair of the angles 30 by a pair of spaced, oppositely opening channel members 32 each of which engages one angle of each pair. Rigidly secured to the yoke shown in Fig. 17 as by bolts 33 is a conventional underwater pile hammer generally designated 34 which serves to drive each of the piles 35 into the bed of the ocean.

Secured to each pile at spaced points along the length of the same are yokes 36 which are similar to yokes 31, but which are spaced from the piles 35 by means of brackets 37 so that the longitudinal centerline of the pile is in alignment with the line of action of the pile hammer.

The use of underwater pile driving hammers per se is not new and no claim is made to such use except in combination with the present invention.

The brackets 37 may be lightly tack welded to the pile 35 (Fig. 18) so that upon engaging the flange 13 the brackets 37 will be broken off the piles by additional blows of the pile driver. Of course, by the time the yokes 36 and their associated brackets 37 have reached the flanges 13 these brackets have substantially performed their function of guiding the pile since the pile has entered the bed of the ocean at its lower end. The spacing of yokes 36 is shown in Fig. 12 but it is obvious that the spacing shown in the drawings may be changed as desired so long as the pile is sufficiently stable to resist buckling. It will be noted from Fig. 12 that the lower end of the pile hammer 34 is sufficiently spaced from the lower yoke 31 so that the completely driven pile will be below the flange 13. This is for the purpose of permitting subsequent removal of the caisson free of the piling if desired. This removal will subsequently be described in detail.

In the event that levelling of the caisson is required before driving the piles or before finally securing the caisson to the ocean bed one pile may be employed in combination with a jack adjacent the top of the casing which it is desired to raise. In Fig. 12 a pile 50 is shown employed in this manner. A conventional hydraulic jack 51 is secured at one of its ends to a strong back 52 which may be temporarily though rigidly secured to the top of the casing 3 as by welding. Several yokes 36 may be secured to the pile 50 at spaced points along its length to prevent buckling of the pile during the jacking operation. By actuating the jack 51 the casing 3 may be raised until the tops of the legs 1, 2 and 3 are in the same horizontal plane. If required by the irregularity of the ocean bed, the jacking operation above described may be carried out on two of the three casings to bring the caisson to a vertical position. Thus it is seen that the use of the angles 30 in combination with the piles 35 and the jacking pile 50 provide an effective means for manipulating the caisson after it has been brought to its final position at the drilling site.

After the piles have been driven to depth at which their upper ends are adjacent the lower end of the caisson but projecting above the ocean bed, concrete may be poured around the base to anchor the caisson securely in place. Sur-

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rounding the lower end of each leg is an open-ended cylindrical chamber or skirt generally designated 60 (Fig. 16) into which the concrete is poured so that the upper ends of the piles become imbedded in the concrete after the latter sets. The skirt 60 is slidably secured to a circular shaped frame 61 which in turn is rigidly fastened to a base portion 62 secured to the lower of each of the legs 1, 2 and 3. The base portion 62 is an open-ended cylindrical tube having an annular flange 63 rigidly secured to the upper end thereof and peripherally welded thereto. The outside diameter of flange 63 is preferably equal to the outside diameter of watertight bulkhead 10 and this flange is brought into direct engagement with the flange 13 hereinbefore referred to as the portion of bulkhead 10 extending radially outwardly of the side walls of each of the casings 1, 2 and 3. These flanges may be secured in place relative to each other by bolts during fabrication but such bolts are replaced by straps 64 prior to launching. As seen in Fig. 16 angle clips 65, 66 are secured to the side walls of the watertight cell A and the base portion 62 respectively, adjacent their juncture. Straps 64 may then be welded to the clips 65 and 66 so that these straps securely connect the casing with the base portion. As will be subsequently described, the straps 64 may be burned through by a diver if desired to release the caisson to move it to a new site.

Referring to Fig. 16, the frame 61 comprises a pair of circularly formed angle bars 70, 71 which are spaced longitudinally of the base 62 and secured together by members 72. Angle 70 is rigidly secured to the base portion 62 by means of diagonal braces 73 so that the angle bars 70, 71 which define the periphery of frame 61 are concentric with and spaced from the base portion 62.

The skirt 60 is slidably supported on the frame 61 so that it may be moved longitudinally of the leg. Angle bar 75 is rigidly secured around the inner periphery of the skirt 60 adjacent its upper open end and a similar angle bar 76 is similarly secured to the skirt adjacent its lower open end but preferably spaced therefrom as shown in Fig. 16.

The angle bars 75 and 76 act as stops but permit limited longitudinal movement of the skirt 60 relative to the base portion 62.

When initially launched the skirt 60 may be positioned at its upper limit as shown by dash lines in Fig. 16 and held in place by means of cables 77 secured to lugs 78 on skirt 60 during floating and upending. Before the concrete is poured the cables 77 may be slackened thus permitting the skirt 60 to drop downwardly by gravity onto the ocean bed as indicated by full line in Fig. 16. The circular frame 61 acts as a guide during this movement of the skirt and prevents undesirable tilting of the skirt.

To insure a rigid connection between the piles 35 and the casings 1, 2 and 3 openings 79 may be formed in the base portions 62 to permit the concrete to enter the same. These holes are preferably elongated in a vertical direction so that water trapped in the base portion 62 may escape as the level of the concrete rises during the pouring operation. The operation of pouring "tremie" or underwater concrete is not new in itself and no claim is made herein to such an operation except as the same is used in combination with the present invention. The tremie concrete which is indicated at 80 in Fig. 13 should be of sufficient quantity to insure an ade-

quate connection between the caisson and the piling. In Fig. 16 one pile only is indicated to show its relative position with respect to the leg and the skirt 60. This pile is indicated in dot-dash line for clarity.

Levelling and anchoring means for hard bed

Figs. 10, 13 and 14 illustrate the method employed to anchor the caisson to a relatively hard ocean bed. In such a case the use of piles may be obviated and the method of anchoring the caisson becomes correspondingly simplified, it being only necessary to pour the concrete adjacent the base of each leg in the manner hereinbefore described.

However, means must be provided for levelling the caisson in the event that the ocean bed is irregular at the site. In lieu of the piles employed as above described for jacking the caisson we employ an elongated column or "spud" generally designated 90 (Figs. 13, 14) which is adapted to be inserted into each of the legs 1, 2 and 3 for movement longitudinally of the latter. For the purpose of guiding these spuds 90 a cylindrical guide tube 91 is formed in each of the legs 1, 2 and 3 and extends throughout the length of cells A and B (Fig. 13). Communicating with the cylindrical guide tube 91 is another guide tube 92 rigidly secured within the base 62. Guide tube 92 is in alignment with guide tube 91 so that the spud 90 may extend into and through the base 62. The guide tube 92 is provided with a flange 93 adjacent its upper end for securing the tube to the watertight bulkhead 10. This flange 93 may be formed integrally with the flange 63 and if desired the flange 93 may be lightly tack welded to the lower watertight bulkhead 10. This flange 93 may be formed integrally with the flange 63 and if desired the flange 93 may be lightly tack welded to the lower watertight bulkhead 10 of the caisson leg so that upon severing the straps 64 as hereinbefore described, the caisson may be completely released from the base 62 and also from the guide 92.

The cylindrical guide 92 is somewhat larger in diameter than the guide 91 and a sleeve generally designated 94 is adapted to be slidably received within said guide. This sleeve 94 is approximately equal in length to the height of base 62 and comprises an outer wall 95 slidably within guide 92 and an inner wall 96 within which the spud 90 is adapted to be moved longitudinally of the caisson. The walls 95 and 96 are concentric and are radially spaced by longitudinally extending flat bars 97 rigidly secured to said walls (Fig. 19).

For the purpose of centering the spud 90 within the guide 91 and sleeve 94 circular spacers 100 are rigidly secured to the spud 90 at spaced points along its length (Fig. 14). The inside diameter of inner wall 96 is approximately equal to the inside diameter of guide 91 so that the spud 90 may be inserted through the full vertical extent of the caisson leg.

The lower end of the spud 90 is provided with a circular base 101 rigidly secured to the leg and having a diameter approximately equal to the diameter of the spud spacers 100 so that said base may be inserted through the guide tube 91 and sleeve 94.

Rigidly secured to the lower end of sleeve 94 is a circular spud shoe 102 which is substantially larger in diameter than the base 101 and which is adapted to bear against the ocean bed to partially support the weight of the caisson. This

spud shoe 102 is preferably formed of a relatively large circular plate 103, reinforced by stiffeners 104 and rigidly secured to the lower end of sleeve 94 by means of plate 105.

It should be noted that the spud 90 is not connected to spud shoe 102 although it coacts therewith. To permit even distribution of the force exerted between the spud base 101 and the spud shoe 102 we provide a sand cushion 106 at the lower end of sleeve 94. The sand 106 transmits the force from the spud base 101 to the spud shoe 102 and prevents localized distortion of the spud base or spud shoe. It will be apparent that upon removal of the caisson from the drilling site, the sleeve 94 and spud shoe will remain but the spud may be withdrawn from the base 62 and removed along with the caisson. To prevent accidental removal of the sleeve 95 during the sinking operation the same may be lightly tack-welded to the guide 92. Upon subsequent use of the spud 90 the sleeve will be broken loose.

Fig. 13 shows a general arrangement of leg 2 of the caisson for a hard bed installation. Strongback 52 and jack 51 may be employed in the same manner as they are employed in the soft bed installation shown in Fig. 12 except that the jack 51 is positioned within compartment C. It will be noted that legs 1, 2 and 3, when arranged as shown in Fig. 13 for hard bed installations, may be formed with the longitudinal stiffeners 30 secured to the inner periphery of the legs instead of to the outer periphery as shown in the soft bed installation of Fig. 12. This construction provides less resistance to the movement of water past the legs and is possible because no pile driving operation need be performed in the case of a hard bed installation.

To compensate for the piles 35 employed in a soft bed, it is preferable that the skirt for retaining the concrete be somewhat larger when no piling is used. The skirt 107 shown in Fig. 13 is therefore somewhat larger than skirt 60 of Fig. 12 but it will be understood that in other respects the installation of skirt 107 is identical to the installation of skirt 60.

For the purpose of carrying on the actual drilling operation from the deck 4 a plurality of oil drilling casings 110 (Figs. 1-6) may be rigidly secured to the bracing 6 in any convenient manner. These drilling casings may be open ended and are only for the purpose of guiding the drills pumping lines and associated tools during the actual drilling processes and preferably extend substantially the length of the caisson.

In the drawings the legs 1, 2 and 3 have been shown parallel to each other but this particular shape is not essential although it is economical to make. If desired the legs 1, 2 and 3 may slope inwardly and upwardly toward each other so that the base of the caisson when installed on the ocean bed is somewhat larger than the top of the caisson on which the deck is constructed. By this modification a more stable structure is achieved. However it is pertinent to note that the cross-sectional shape of the caisson should be triangular at any point along the length of the caisson with the legs 1, 2 and 3 at the apex of each triangle for the reasons hereinbefore given.

The invention herein disclosed has been described with respect to two different types of ocean beds. It will be apparent that the quality of the ocean bed encountered may actually be somewhere between hard and soft so that the particular structure employed may combine ele-

ments of both examples of the invention herein described.

It will be apparent that in relatively shallow water installations the piles may be driven at all times by a conventional pile hammer without requiring underwater pile driving and by welding additional sections of piles together as the pile driving operation progresses. In such a case the upper ends of the piles may be left projecting above the water level and the piles rigidly secured to the legs by welding the yokes 36 to both the piles and the legs. This type of installation may obviate the necessity of pouring concrete and permits withdrawal of the piles when it is desired to move the caisson to another site. However, in the relatively deep water installations contemplated by the present invention the use of a concrete anchor as hereinbefore described is preferable.

I claim:

1. An off-shore drilling structure comprising an elongated caisson adapted to be floated horizontally to a desired site for up-ending onto the bed of the ocean, said caisson comprising three spaced elongated integrally connected tubular legs for supporting an oil drilling deck thereon, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into substantially air tight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while waterborne and for sinking said caisson for supporting the same on said bed.

2. An off-shore drilling structure comprising an elongated caisson adapted to be floated horizontally to a desired site for up-ending onto the bed of the ocean, said caisson comprising three spaced elongated integrally connected tubular legs for supporting an oil drilling deck thereon, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into substantially air tight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while waterborne and for sinking said caisson for supporting the same on said bed, means carried by each of said legs for tilting said caisson to a generally vertical position while said caisson is supported on said bed.

3. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean, said caisson comprising three spaced elongated tubular legs for supporting an oil-drilling deck thereon, said caisson having a cross-section substantially in the form of a triangle with one of said legs at each apex thereof, longitudinally extending open ended casings secured to said caissons adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into substantially watertight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is water-borne and for sinking said caisson for supporting the same on said bed, guide means integrally secured to each of said legs for slidably supporting an underwater pile driver for driving piles longitudinally of said legs and adjacent the periphery of the latter.

4. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean, said

5 caisson comprising three spaced elongated tubular legs for supporting an oil-drilling deck thereon, said caisson having a cross-section substantially in the form of a triangle with one of said legs at each apex thereof, longitudinally extending open ended casings secured to said caissons adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into substantially water-tight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is waterborne and for sinking said caisson for supporting the same on said bed, a chamber supported by each of said legs and surrounding the latter adjacent their lower ends for receiving a charge of concrete for connecting said legs to said bed.

5. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean with its upper end above the sea level and with its lower end on the ocean bed, said caisson comprising three spaced elongated integrally connected tubular legs for supporting an oil drilling deck thereon adjacent said upper ends, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into a plurality of watertight cells, said legs being provided with tubular base portions removably secured to said legs adjacent their lower ends for supporting said legs on said bed with said base portions between said legs and said bed, means for rigidly securing said base portions to said bed whereby said legs may be released from said base portions for removing said caisson from said site.

6. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean with its upper end above the sea level and with its lower end on the ocean bed, said caisson comprising three spaced elongated integrally connected tubular legs for supporting an oil drilling deck thereon adjacent said upper ends, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into a plurality of watertight cells, said legs being provided with tubular base portions adjacent their lower ends for supporting said legs on said bed with said base portions between said legs and said bed, a chamber carried by each of said base portions and surrounding the latter and adapted to be supported on said bed for receiving a charge of concrete, openings in the sides of said base portions communicating with said chamber for permitting said concrete to enter said base portions.

7. An off-shore drilling structure comprising a vertical caisson supported at its lower end on the bed of the sea with its upper end above sea level, said vertical caisson comprising spaced elongated integrally connected tubular legs extending substantially the length of said caisson, transverse partitions in said legs at spaced points along the length of the latter dividing said legs into substantially watertight cells, tubular base

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portions secured to the lower ends of said legs and coaxial therewith for supporting said legs with their lower ends spaced from said bed, stiffeners extending longitudinally of said legs and rigidly secured thereto for slidably supporting an underwater pile hammer for movement longitudinally of said legs, said stiffeners being arranged in an annular row extending circumferentially of said legs for supporting such a pile driver at spaced points around the periphery of said legs and for driving piles arranged in an annular row concentric with said legs and radially spaced therefrom, an open ended cylindrical chamber carried by each of said base portions and adapted to be supported on said bed radially outwardly of said row of piles, said chamber being adapted to receive a charge of concrete for rigidly securing said piles to said base portion.

8. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean, said caisson comprising three spaced elongated tubular legs for supporting an oil-drilling deck thereon, said caisson having a cross-section substantially in the form of a triangle with one of said legs at each apex thereof, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into substantially watertight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is waterborne and for sinking said caisson for supporting the same on said bed, an elongated jacking member extending between the upper and lower ends of each of said legs and adapted to engage said bed at its lower end, jacking means adjacent the upper end of one of said elements for urging the latter toward said bed and for moving said one leg in a direction away from said bed for levelling said deck.

9. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean, said caisson comprising three spaced elongated tubular legs for supporting an oil-drilling deck thereon, said caisson having a cross-section substantially in the form of a triangle with one of said legs at each apex thereof, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into substantially watertight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is waterborne and for sinking said caisson for supporting the same on said bed, an elongated jacking member extending between the upper and lower ends of each of said legs and adapted to engage said bed at its lower end, jacking means adjacent the upper end of one of said elements for urging the latter toward said bed and for moving said one leg in a direction away from said bed for levelling said deck, interengaging elements on said one leg and said jacking element for supporting the latter against buckling during said movement, said elements comprising longitudinally extending stiffeners on said legs and yokes carried by said jacking elements at spaced points along their lengths

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slidably secured to said stiffeners for movement longitudinally of said legs.

10. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean, said caisson comprising three spaced elongated tubular legs for supporting an oil-drilling deck thereon, said caisson having a cross-section substantially in the form of a triangle with one of said legs at each apex thereof, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing said legs into substantially watertight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is waterborne and for sinking said caisson for supporting the same on said bed, an elongated jacking member extending between the upper and lower ends of each of said legs and adapted to engage said bed at its lower end, jacking means adjacent the upper end of one of said elements for urging the latter toward said bed and for moving said one leg in a direction away from said bed for levelling said deck, means carried by said legs for supporting said jacking members against buckling, said means comprising a guide casing within said legs extending longitudinally between the upper and lower ends of said legs and guide elements secured to said jacking element at spaced points along the length of the latter for slidably engaging said casing.

11. An off-shore drilling structure comprising an elongated three sided caisson adapted to be floated horizontally on one side to a desired site for up-ending onto the bed of the ocean with its upper end above the sea level and with its lower end on the ocean bed, said caisson comprising three spaced elongated integrally connected tubular legs for supporting an oil drilling deck thereon adjacent said upper end, longitudinally extending open ended casings secured to said caisson adapted to pass drilling and pumping lines to said bed, transverse partitions in said legs dividing them into a plurality of watertight cells, said legs being provided with tubular base portions adjacent their lower ends for supporting said legs on said bed with said base portions between said legs and said bed, levelling means carried by each of said legs and said base portions for swinging said caisson to a vertical position when said bed is irregular, said means comprising an elongated jacking member within said legs extending between the upper and lower ends of the lower ends of the latter and extending into said base portions and a bed engaging element carried by said base portion and slidably therein, jacking means carried by said legs adjacent their upper ends for urging said jacking member downwardly against said bed for selectively raising said legs off said bed.

12. In an off-shore drilling structure having three equally spaced air tight hollow legs connected together for floating said structure with two of said legs horizontal in the water and with the third leg above the water level, means for selectively and progressively displacing the air in one of the corresponding ends of said legs whereby said legs may be up-ended in the water and stabilized during such movement against rolling about a longitudinal axis common to said legs.

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13. In an off-shore drilling structure having three equally spaced air tight hollow legs connected together for floating said structure with two of said legs horizontal in the water and with the third leg above the water level, means for selectively and progressively displacing the air in one of the corresponding ends of said legs whereby said legs may be up-ended in the water and stabilized during such movement against rolling about a longitudinal axis common to said legs and means carried by said legs for supporting them on the bed of the ocean substantially normal to the water level irrespective of irregularities in the surface of said bed.

14. In an off-shore drilling structure having three equally spaced air tight hollow legs connected together for floating said structure with two of said legs horizontal in the water and with the third leg above the water level, means for selectively and progressively displacing the air in one of the corresponding ends of said legs whereby said legs may be up-ended in the water and stabilized during such movement against rolling about a longitudinal axis common to said legs, and a levelling member carried by at least one of said legs movable longitudinally thereof and downwardly when said legs are up-ended with said corresponding ends down.

15. In an off-shore drilling structure having equally spaced vertically extending legs in side by side relationship for supporting well drilling equipment, piles extending longitudinally of said legs connected therewith for downward movement and means on said legs for driving said piles downwardly, a skirt around the lower end of each of said legs and secured thereto through which said piles are adapted to move upon being driven downwardly, said skirt being adapted to hold concrete with a portion of each of said piles imbedded therein for thereby securing said piles to said legs.

16. In an off-shore drilling structure having equally spaced vertically extending legs in side by side relationship for supporting well drilling equipment, piles extending longitudinally of said legs connected therewith for downward movement and means on said legs for driving said piles downwardly, elongated members secured to said legs extending longitudinally thereof and means for slidably connecting said piles and said means to said members.

17. An off-shore drilling structure comprising a vertical caisson supported at its lower end on the bed of the sea with its upper end above sea level, said caisson comprising spaced elongated integrally connected tubular legs extending substantially the length of said caisson, transverse partitions in said legs dividing said legs into substantially watertight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is waterborne and for sinking said caisson for supporting the same on said bed, an elongated jacking member extending between the upper and lower ends of each of said legs and adapted to engage said bed at its lower end, jacking means adjacent the upper end of one of said elements for urging the latter toward said bed and for moving said one leg in a direction away from said bed for levelling said deck.

18. An off-shore drilling structure comprising a vertical caisson supported at its lower end on

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the bed of the sea with its upper end above sea level, said caisson comprising spaced elongated integrally connected tubular legs extending substantially the length of said caisson, transverse partitions in said legs dividing said legs into substantially watertight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is waterborne and for sinking said caisson for supporting the same on said bed, an elongated jacking member extending between the upper and lower ends of each of said legs and adapted to engage said bed at its lower end, jacking means adjacent the upper end of one of said elements for urging the latter toward said bed and for moving said one leg in a direction away from said bed for levelling said deck, interengaging elements on said one leg and said jacking element for supporting the latter against buckling during said movement, said elements comprising longitudinally extending stiffeners on said legs and yokes carried by said jacking elements at spaced points along their lengths slidably secured to said stiffeners for movement longitudinally of said legs.

19. An off-shore drilling structure comprising a vertical caisson supported at its lower end on the bed of the sea with its upper end above sea level, said caisson comprising spaced elongated integrally connected tubular legs extending substantially the length of said caisson, transverse partitions in said legs dividing said legs into substantially watertight cells, means for selectively admitting water into said cells for swinging said caisson from a horizontal to a vertical position while the same is waterborne and for sinking said caisson for supporting the same on said bed, an elongated jacking member extending between the upper and lower ends of each of said legs and adapted to engage said bed at its lower end, jacking means adjacent the upper end of one of said elements for urging the latter toward said bed and for moving said one leg in a direction away from said bed for levelling said deck, means carried by said legs for supporting said jacking members against buckling, said means comprising a guide casing within said legs extending longitudinally between the upper and lower ends of said legs and guide elements secured to said jacking element at spaced points along the length of the latter for slidably engaging said casing.

THEODORE M. KUSS.

RALPH DENTON RUSSELL.

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