

July 16, 1963

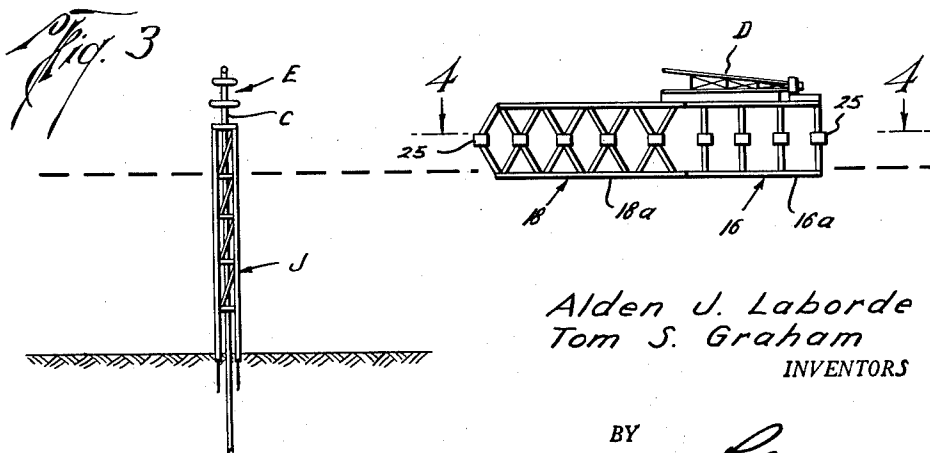
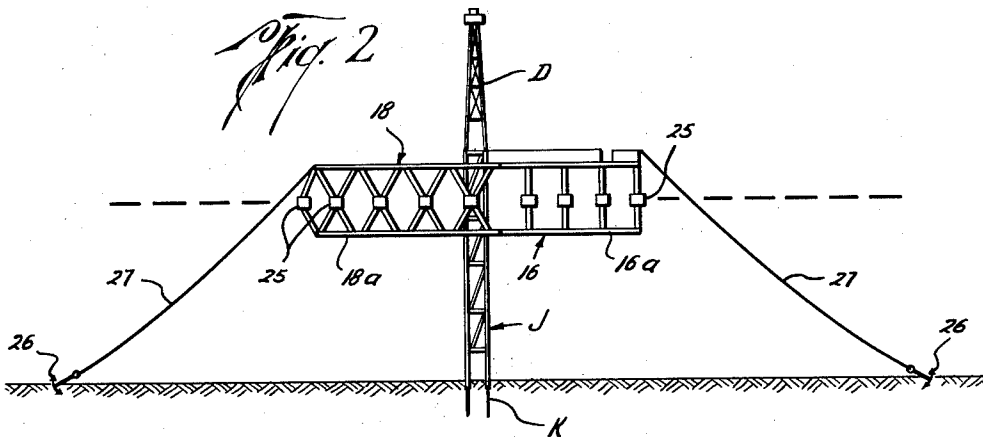
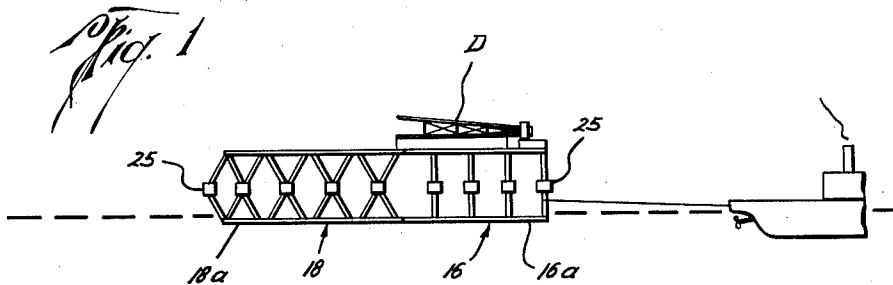
A. J. LABORDE ETAL

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PLATFORM FOR AFLOAT-CONDITION DRILLING

Filed May 27, 1959

5 Sheets-Sheet 1



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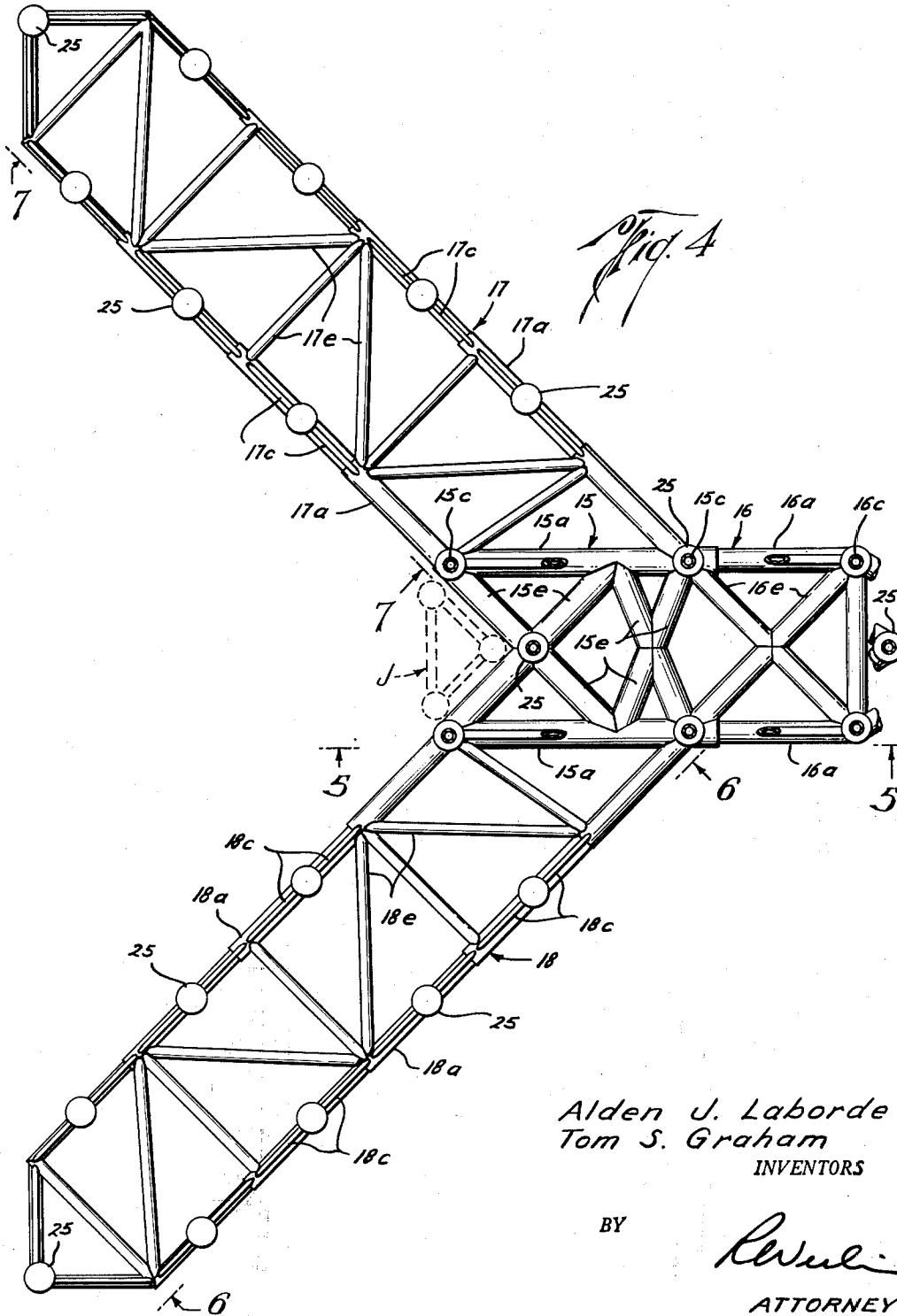
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PLATFORM FOR AFLOAT-CONDITION DRILLING

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5 Sheets-Sheet 2



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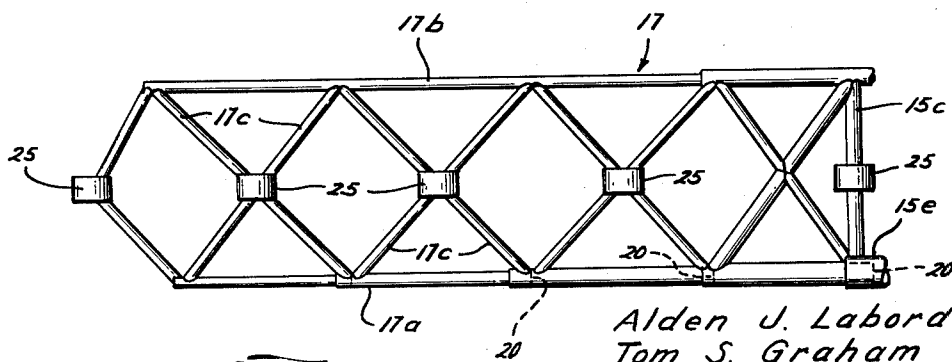
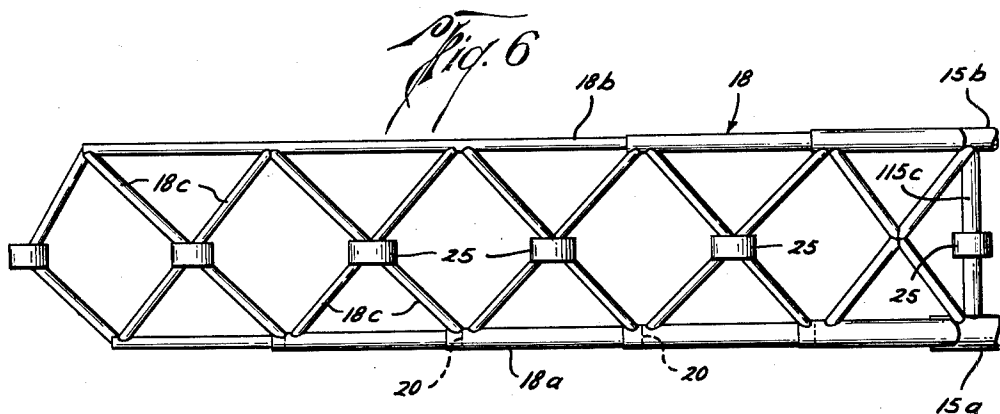
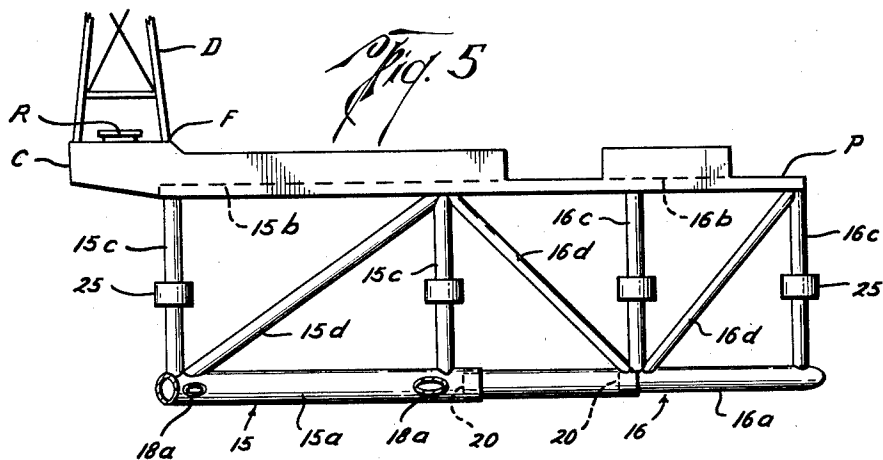
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PLATFORM FOR AFLOAT-CONDITION DRILLING

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5 Sheets-Sheet 3



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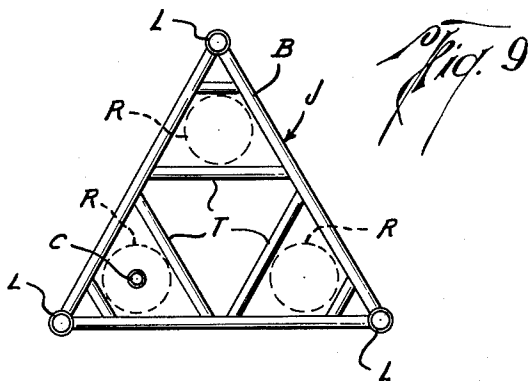
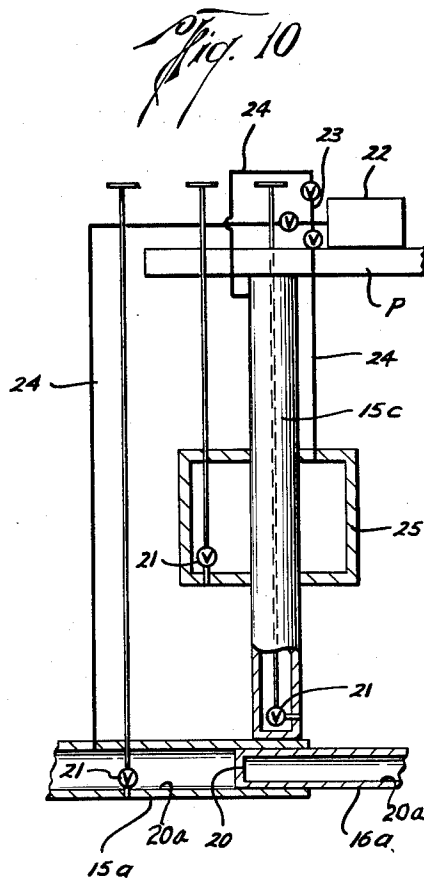
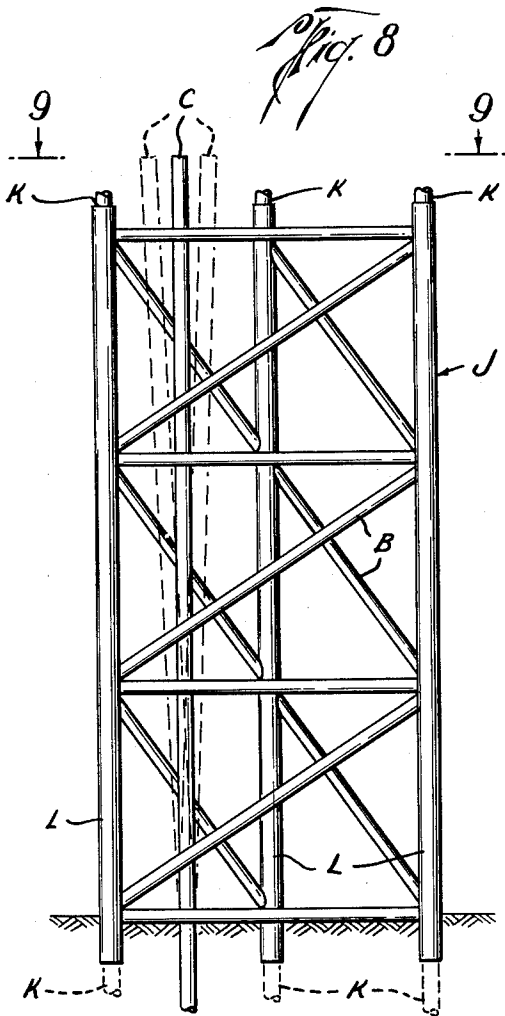
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PLATFORM FOR AFLOAT-CONDITION DRILLING

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5 Sheets-Sheet 4



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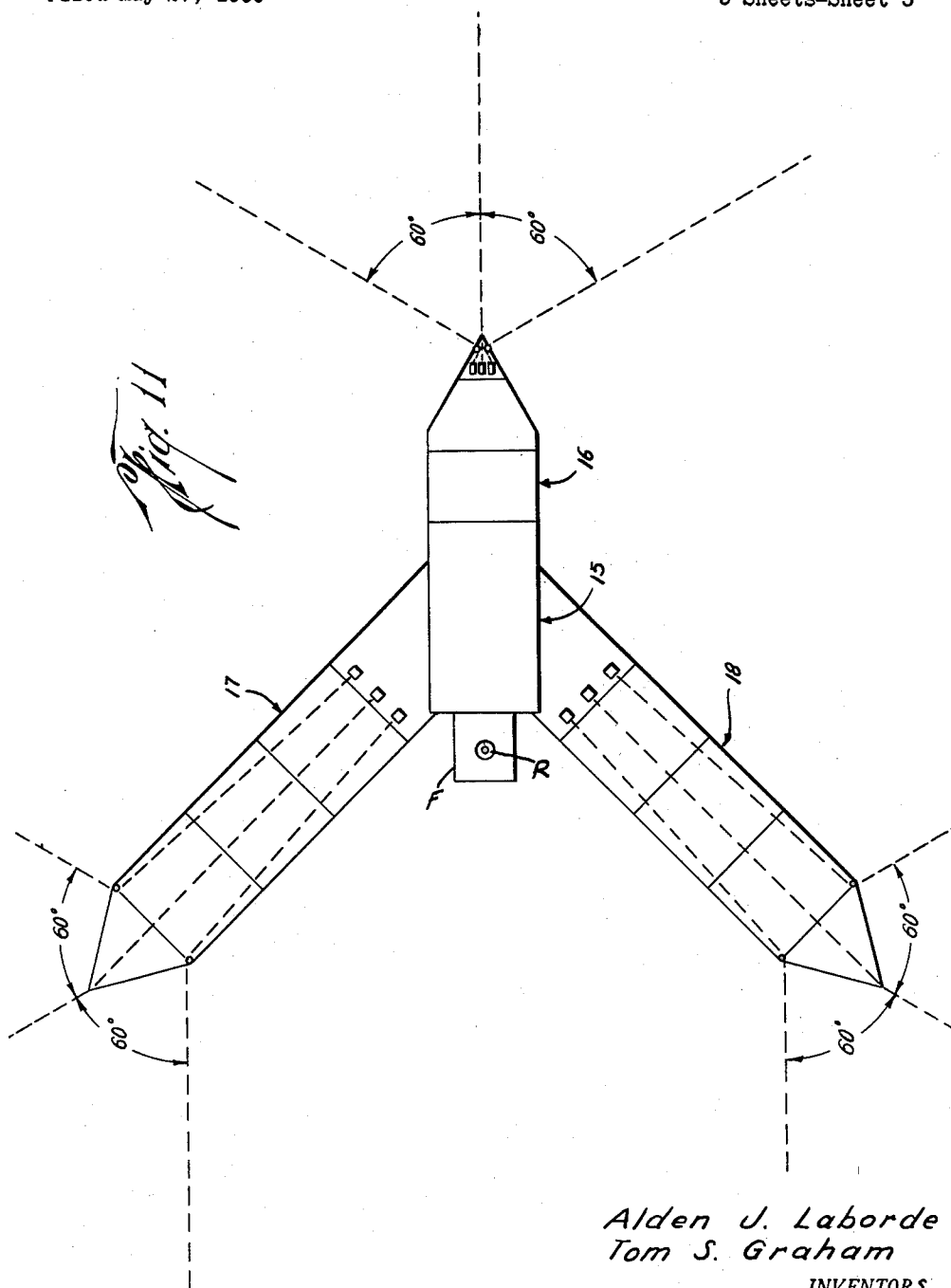
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PLATFORM FOR AFLOAT-CONDITION DRILLING

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5 Sheets-Sheet 5



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3,097,495

PLATFORM FOR AFLOAT-CONDITION DRILLING
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3 Claims. (Cl. 61-46.5)

This invention relates to marine drilling structures and particularly to structures adapted for drilling wells in off-shore locations, the structures being of the types which are maintained in the "afloat-condition" during drilling.

The term "afloat-condition" applies to the condition under which drilling operations are conducted in sub-natant land from a drill-supporting structure which is maintained in floating condition in the overlying water body throughout the drilling operation.

Heretofore the search for hydrocarbon reserves underlying the earth's oceans has been conducted from various types of drilling rig foundations which generally have been affixed, either permanently or temporarily, to the ocean bottom by various devices, such as submersible hulls, legs, or piles which form more or less rigid connections between the drilling platform and the land. These more conventional types of structure have proven quite successful in drilling in water depths which are comparatively shallow, that is, depths up to about 100 feet. However, as the search progresses to land areas underlying water depths greatly in excess of 100 feet, the present types of fixed structures become uneconomical and impractical.

More recently, systems have been developed for afloat-condition drilling which have been applied largely to core drilling, and in most instances are conducted in such a fashion that the well head equipment is located beneath the water surface on the underlying land, the drilling tools and well equipment being guided into place and directed by means of guide lines extending between the underwater wellhead equipment and the vessel on the surface from which the drilling is conducted.

All of the floating rigs thus far employed in afloat-condition drilling have been converted from various types of conventional types of ships, such as YF's, LSM's, mine sweepers, and the like, these ships having been equipped with certain standard drilling equipment and the drilling operation being carried on over the side or through a bay or opening in the hull. Position over the well bore is maintained by the use of conventional anchoring methods. These ships are markedly subject to the action of wave and wind, since they necessarily present relatively large surface areas to the forces exerted by these elements, and while some movement is, of course, permissible, depending upon the flexibility of the drill pipe extending between the vessel and the underlying land, any moderately severe weather conditions forces cessation of drilling operations with its attendant economic losses, and renders these ships subject to the hazards resulting from their movements under storm conditions.

The present invention, therefore, has for its primary object the provision of a new type of drilling platform which is especially adapted for afloat-condition drilling under conditions which render the use of the more conventional types of ships impractical, and which may be employed for afloat-condition drilling in water depth greatly in excess of 100 feet.

An important object is the provision of a drilling rig support or base which is adapted to float in partly sub-

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merged condition and has a high degree of wave-transparency in order to minimize wave effect thereon; which is nautically stable both when afloat and when in the partly submerged drilling condition; which possesses a high degree of vertical stability under varying loads; and which is subject to minimum change in horizontal attitude under such varying loads.

The drilling rig base contemplated in accordance with this invention comprises a wave transparent structure constructed from a plurality of elongate hull elements radiating in angular relation to each other from a common center section and in a generally symmetrical arrangement, the center section preferably serving to support the drilling rig and its accompanying equipment, while the radiating elements provide the principal stabilizing elements of the structure.

Another important feature in accordance with the present invention, is the provision of specialized elements in the base structure by which a high degree of vertical stability is assured under varying loads applied during drilling, this being important to reduce the extent of immersion and of tilt or angular movement which would otherwise occur under the change in loads applied during operations of the drilling rig.

In accordance with the present invention, the radiating hull elements, as well as the center section, are constructed in the form of elongate openwork structural frames, each frame being defined by horizontally disposed, longitudinally extending, laterally and vertically spaced hollow tubular stringers. The latter are inter-connected by a number of hollow, generally tubular vertical columns and diagonal bracing elements necessary to impart sufficient strength and rigidity to the hull elements while providing a high degree of wave-transparency to the structure as a whole.

The lower pair of stringers, particularly those underlying the center section, constitute the primary hull members and are dimensioned and suitably compartmented to form buoyant supports capable of supporting the entire structure in nautically stable condition when afloat on the surface. The vertical columns and diagonal bracing elements connecting the hull members with the upper stringers form buoyant upward extensions of the hull members. The compartments of the hull members and at least some of the columns and diagonal bracing elements are provided with appropriate and generally conventional gear for selectively ballasting and de-ballasting them in order to accomplish the desired degree of submergence of the hull members and to raise the same back to the water surface.

In order to provide the increased load-supporting capacity in its partly submerged working position, the water plane area of the structure at the working level between the upper and lower stringers in substantially increased over a relatively short vertical distance. This increase may be accomplished by mounting between the upper and lower stringers a plurality of suitably arranged generally cylindrical, hollow casings of larger cross section than the vertical columns and diagonal bracing elements. These casings may constitute enlargements in the vertical columns or may be secured to or formed as part of the diagonal bracing elements, or both arrangements may be employed. Their effect is to increase the tons-per-inch-immersion of the structure at this water line to the minimum required for efficient operation, but without increasing the size of the columns over their full length, thus keeping wave resistance at a minimum and reducing

cost, while maintaining vertical movement of the structure under varying loads to the desirable minimum.

Also, in accordance with this invention, the center of the drilling station, which generally coincides with the center of the rotary table, will preferably be located at substantially the center of flotation of the structure when the latter is at the working level having the increased water plane area above-mentioned. With this arrangement the movements of the structure under the varying loads which occur during drilling will be limited largely to vertical movements, thereby assuring minimum angular change in the horizontal attitude of the structure under such varying loads. At the same time, as previously noted, the extent of the vertical movements will be greatly limited by the increased water plane area at the working level. Moreover, by suitable disposition of the enlarged casings about the several elements of the base structure, the center of flotation may be located in the angle between two of the radiating hull elements, thereby permitting the drilling position to be located in this angular area which thus permits the base structure to be readily removed from about a well and its surrounding protective jacket when drilling is completed.

Also, in the event of accidental horizontal movement of the structure due, for instance, to failure of the anchors or cables, the wide angle opening in the structure about the drilling well increases considerably the chances of swinging clear of the well as compared to conventional long, narrow slotted type openings which have been used in over-water drilling.

Other and more specific objects and advantages of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with this invention.

FIG. 1 is a generally diagrammatic side profile of a base structure in accordance with this invention, the view showing the structure floating on the surface of a water body in the towing position for movement from place to place.

FIG. 2 is a view similar to FIG. 1, showing the structure in the partly submerged afloat-condition for drilling with the derrick in place and a protector jacket, through which drilling is conducted, in position in the underlying land;

FIG. 3 is a view generally similar to FIG. 1, showing the structure re-floated and being moved away from the completed well and its protector jacket;

FIG. 4 is a transverse sectional view taken generally along line 4—4 of FIG. 3, showing the general configuration of the base structure;

FIGS. 5, 6 and 7 are side profiles viewed generally along lines 5—5, 6—6, and 7—7, respectively, of FIG. 4;

FIG. 8 is an elevational view of the protector jacket through which the drive pipe for the well extends and indicating in broken lines the lateral movement in which the upper end of the drive pipe may engage during the drilling operation;

FIG. 9 is a top view of the protector jacket viewed along line 9—9 of FIG. 8;

FIG. 10 is a diagrammatic, partly sectional view illustrating the ballasting gear for some of the structural elements of the base; and

FIG. 11 is a diagrammatic plan view of the base structure showing its general configuration and indicating the arrangement of the anchoring means employed to maintain the structure in position over a well location.

Referring to the drawing and particularly to FIGS. 4 to 7, the base structure comprises three hull elements, designated generally by the numerals 16, 17 and 18, respectively, which radiate in angular relation from a common center section, designated generally by the numeral 15. Hull element 16 may constitute an extension of center section 15, as shown.

Each of the elements comprises an openwork elongate

structural frame which is generally rectangular in cross-section and has a length much greater than its transverse dimensions. Each of the rectangular frames is defined by upper and lower pairs of horizontally spaced longitudinally extending stringers. The lower pair of stringers for center section 15 are designated by the numerals 15a—15a, and for elements 16, 17 and 18 by the numerals 16a—16a, 17a—17a, and 18a—18a, respectively. The upper pairs of stringers for the several elements are designated, respectively 15b—15b, 16b—16b, 17b—17b, and 18b—18b. The sides of the frames are formed by a number of spaced-apart vertical columns and diagonal bracing elements which extend between the upper and lower stringers of the respective hull elements. In the case of center section 15 and hull element 16, the vertical columns are numbered 15c and 16c, respectively, and the diagonal bracing elements are numbered 15d and 16d, respectively. In the case of hull elements 17 and 18, only diagonal bracing elements 17c and 18c, respectively, are illustrated, although these frames may likewise employ vertical inter-connecting columns as well as the diagonal bracing elements. The upper and lower pairs of stringers may each also be inter-connected transversely by a plurality of tying and bracing elements, best seen in FIG. 4, designated respectively by the numerals 15e, 16e, 17e and 18e for the several hull elements.

All of the various structural components comprising the several hull elements are preferably tubular and cylindrical and the number and their arrangement are such as to provide the desired degree of strength and rigidity in each of the hull elements, while at the same time, providing the maximum degree of wave transparency throughout the base structure. However, the upper stringers of each element may be constructed of structural shapes other than tubular or cylindrical.

It will be noted that in the illustrative embodiment, hull elements 17 and 18 are positioned at an angle of 90° to each other, while they are disposed at an angle of 135° with respect to element 16. It will be understood that the angular relations may be other than those employed in this illustrative embodiment, and also that while three radiating elements are illustrated, a larger number may be employed. It will be understood that where a larger number is employed, they will ordinarily be disposed generally symmetrically with respect to the center of the structure.

The lower stringers 15a, 16a, 17a and 18a may be progressively reduced in diameter toward the outer ends, as illustrated, and are provided with suitable internal bulkheads 20 located at longitudinally spaced points in order to form a plurality of ballast compartments 20a within the interiors thereof.

FIG. 10 illustrates, more or less diagrammatically, generally conventional valving and pumping gear by which the compartments in the lower stringers, and in at least some of the columns and diagonal braces, may be selectively ballasted and de-ballasted in order to submerge and re-float the structure. As there illustrated, valves 21 are suitably positioned in the various structural elements to admit sea-water to the interiors thereof, while a compressor 22 may direct air through a header 23 connected to the various compartments by suitable air-lines 24 for blowing or de-ballasting these compartments. Compressor 22 may be replaced by suitable pumps for introducing and removing ballast. It will be understood that the ballasting and de-ballasting gear is entirely conventional and the specific details thereof form no part of this invention.

Center section 15 and radiating element 16 support the main deck or working platform P (FIG. 5) on which are mounted the crew quarters, machinery and equipment enclosures, pipe racks, and other equipment and appurtenances employed in connection with the drilling operation. Thus, the principal load on the structure will be

concentrated in this area of the structure. One end of the working platform projects beyond the end of center section 15 into the angular area included between radiating elements 17 and 18. This projecting portion of the working platform constitutes the drilling station which includes the rig floor F, on which is mounted the derrick D which is positioned over the rotary table R, through which drilling is conducted in the usual manner through a drilling cellar C located within the confines of the drilling station below the rig floor.

A plurality of hollow, generally cylindrical casings 25 are mounted at longitudinally and laterally spaced points at a uniform level between the upper and lower strings throughout the several elements of the base structure. These casings may be mounted concentrically about the vertical columns 16c or at the intersection of the diagonals 17c and 18c, as illustrated in the several views, or in any other suitable manner which will rigidly support them at the desired locations. The level at which these casings are positioned will be the normal working water-surface level for the base structure when the lower stringers, comprising the primary hull elements have been submerged to a depth below that at which the forces of wave action can be effective thereon.

The primary function of the casings 25 is to increase the water plane area at the working level as compared with the water plane areas of any other level between the upper and lower stringers. In this way the supporting capacity of the structure at that level is substantially increased, increasing the tons-per-inch-immersion factor of the structure to a maximum and rendering the structure substantially more stable to vertical movement under the varying loads which occur during drilling, and still maintaining the minimum remaining structure for maximum transparency and minimum resistance to wave forces. The spatial arrangement and size of these enlarged casings 25 will be selected to provide the minimum water plane-to-displacement ratio which is practically attainable for a structure of the kind herein described, and to locate the center of flotation of the structure, when at the working level, at a point which will substantially coincide with the center of the rotary table. By so locating and arranging the enlarged casings, not only will the nautical stability of the base structure be greatly enhanced, but both vertical movements of the structure and changes in its horizontal attitude under varying loads will be greatly reduced, thereby avoiding any dangerous tilting or other excessive movements of the base.

By placing the enlarged casings at suitable distances with respect to the longitudinal and transverse axes of the base structure and generally symmetrical relative thereto, the moments of inertia of their water planes about these axes will be maximums for the particular shape of the structure, an arrangement which results in maximum righting moments and hence, nautical stability. The vertical length of the enlargements 25 will be such as to accommodate a reasonable amount of vertical movement of the base structure under changing loads.

In operation, the lower stringers, comprising the principal hull elements, will be de-ballasted to render them sufficiently buoyant to float the entire structure on the surface of the water body, so that it may be readily moved to the well location (FIG. 1). When positioned over the well location, the lower stringers and selected ones of the vertical and diagonal hull extensions will be appropriately ballasted to submerge the structure to a depth at which the lower stringers will be below any effective wave action thereon (FIG. 2). This degree of submergence will place the base structure at its working level at which the enlarged casings 25 are located and will position the working platform at a suitable elevation above the water surface. It will be understood that the distance between the bottom of the working platform and the stringers will be such that when the lower stringers have been sub-

merged to the proper depth, as noted, the working platform will be at a height above the water surface such as to effectively clear the tops of any waves which may be anticipated in the areas in which the drilling is conducted.

When in working position, a plurality of anchors 26 carried at the ends of cables 27 (FIGS. 2 and 11) will be run out from the ends of the several hull elements in a preferably symmetrical pattern, as illustrated diagrammatically in FIG. 11. As there illustrated, an array of three anchors, attached to cables disposed at angles of 60° to each other, are secured to the end of each of the radiating elements 16, 17 and 18. By reason of the high degree of wave transparency provided by the structure heretofore described, this array of anchors serves to effectively limit all lateral movements of the base structure to practical minimums under even severe storm conditions.

When the structure is submerged to working level and anchored as described, a protector casing or jacket J (FIGS. 8 and 9), constructed generally in form of a triangular openwork structural frame, shaped generally so as to fit within the angular area included between the radiating elements 17 and 18 (FIG. 4), will be put in place beneath the rig floor and secured to the underlying land by means of piles K, which may be driven through the hollow legs L forming the corners of the triangular jacket structure. The legs L are suitably tied together by cross-bracing elements B. The inside angular corners of jacket J may be enclosed by transverse beams T to provide enclosures for the conductor pipe or surface casing C, through which drilling of a well is conducted from the platform. It will be noted that by providing enclosures at the several corners of the jacket, the latter may serve to confine the conductor casings employed for three different wells, all of which may be drilled from the drilling station by appropriately moving the structure by a slight adjustment in the anchor cables. The transverse beams T serve to limit the radial deflection of the upper end of the surface casing, as illustrated particularly in FIG. 8 and as indicated by the broken circles R in FIG. 9, which may result from the movements of the base structure during the conduct of the drilling, so that the deflection will not exceed the yield point of the pipe.

When drilling of the well is completed, the wellhead equipment, designated generally by the letter E (FIG. 3), will be put in place on the well casing and the base structure will be refloated, the anchors released, and the structure moved away from the well (FIG. 3). By locating the drilling station in the angle between radiating elements 17 and 18, it will be seen that the base structure can be moved away from the well and its protector jacket, or returned thereto when necessary, with a minimum of difficulty.

One of the important variables controlling motion of the structure is the length of the hull elements, more particularly the ratio of hull length to wave length. The lengths of the several radiating hull elements are made substantially greater than the longest waves which it is anticipated will be encountered during operation of the structure. As the wave transparent character of the hull elements will permit the waves to course relatively freely through the hull elements, without encountering any large area surfaces, by making hull elements longer than wave lengths, the motions of one increment of the elongate structure which are induced by one wave travelling there-through will be compensated or neutralized by the motions induced in another increment of the structure by a preceding or a following wave, thereby stabilizing and minimizing overall motion of the entire structure. A suitable ratio for this purpose may be 1.2 times the maximum anticipated wave length.

Following is a set of data with respect to the lengths and other dimensions of a base structure and its several elements constructed in accordance with the illustrative embodiment of this invention.

Hull elements:	
Length—	
Elements 17 and 18 (to juncture with center section 15)-----approx--	350
Center section 15 and element 16-----approx--	295
Between outer ends of elements 17 and 18-----approx--	500
Height—Between upper and lower stringers (center-to-center)-----	90
Diameters—	
Lower stringers 15a-----	14
Lower stringers 16a (from juncture with center section 15) progressively decreasing from-----	12 to 11
Lower stringers 17a and 18a (from juncture with center section 15) decreasing progressively from-----	10 to 4
Upper stringers 17b and 18b (from juncture with center section 15) progressively decreasing from-----	6.5 to 4
Vertical columns 16c-----	6.5
Diagonal bracing elements 15d-----	6.5
Diagonal bracing elements 16d-----	4
Diagonal bracing elements 17c and 18c-----	4
Diagonal bracing elements 17e and 18e-----	6
Diagonal bracing elements 15e-----	14
Diagonal bracing elements 16e-----	11
Casings 25—	
Length-----	10
Diameter-----	17

The attenuated construction of the stringers incorporated in the radiating elements is employed for purposes of saving steel and reducing weight, the stabilizing function of these elements being unaffected by such attenuation. It will be understood, of course, that, if desired, these elements may be made uniform in diameter throughout their length.

The stringers 15a which comprise the primary hull elements supporting the center section have the largest diameter and volume, to be capable of buoyantly supporting the maximum loads which normally will be concentrated in the area of this section. In addition, for a long sea voyage or a restricted canal or other passage, the center section is capable of supporting, in the afloat-condition, all the machinery and structure mounted thereon without the radiating hull elements, which could be removed for such voyage or passage, without disturbing the center section. In a base structure of the form and dimensions set forth above, the structure, fully equipped and normally loaded, with have a draft between 9 and 10 feet in the floating position illustrated in FIGS. 1 and 3.

As indicated previously, the number, size and location of the enlarged casings 25 will be determined so as to provide maximum stability when the base structure is in working position, and to place the center of flotation at the working position, in the angular area between the elements 17 and 18, and substantially coincident with the center of the drill. The length of these casings will be made such as to safely accommodate the variations in vertical displacement resulting from the changes in the drilling loads. In a structure of the general dimensions given above, the displacement at the working level is about 12 tons per inch or 144 tons per foot. Accordingly, with the normal working level at the vertical center of the enlarged casings 25, the total downward load required to submerge the total casing volumes would be 720 tons. As noted previously, these downward loads would cause only vertical movement due to the center of flotation being coincidental with the center of the rotary table.

From the foregoing, it will be seen that this invention

provides a base structure for afloat-condition drilling in water depths substantially greater than 100 feet; which possesses a high degree of stability under severe weather conditions; in which the center of flotation in drilling position is substantially coincident with the center of the drill; which may be moved from about a well with a minimum of difficulty; and which requires smaller anchors, less steel, and is consequently lower in cost than more conventional vessels of the same displacement.

By using a protector jacket about the well, as described, the wellhead fittings and controls may be positioned above the surface of the water body to be readily accessible at all times, thereby eliminating the difficulties and hazards attendant upon positioning the wellhead and well controls in submerged locations, as is now being done in afloat-condition drilling.

It will be understood that the cross-sectional shape of the several hull elements may be varied widely. Thus, instead of the rectangular cross-section of the illustrative embodiment, a trapezoidal, triangular, circular, or other geometric shape may be employed which will possess the desired degree of wave transparency and which will have provision for the elements, such as casings 25, of enlarged cross-section at a level intermediate the upper and lower frame elements.

It will be understood that numerous changes and modifications may be made in the details of the illustrative embodiments within the scope of the appended claims without departing from the spirit of this invention.

What we claim and desire to secure by Letters Patent is:
1. A buoyant drilling rig base for afloat condition drilling, comprising, a hull member comprising a wave transparent structural frame defined by vertically spaced upper and lower stringer elements interconnected by hollow tubular bracing elements defining buoyancy elements and disposed in partly submerged floating position in a water body, the lower stringer elements and said bracing elements defining flotation chambers having displacement sufficient to support said base in said partially submerged floating position without rigid connection to the underlying land, a drill support mounted on said hull member, a plurality of auxiliary buoyancy chambers rigidly secured to said bracing elements at a uniform level intermediate the upper and lower stringer elements and partly submerged in the water body, said auxiliary buoyancy chambers being of substantially lesser length than the vertical distance between said upper and lower stringer elements, each of said auxiliary buoyancy chambers having greater water plane area than the portions of said bracing elements extending above and below said auxiliary buoyancy chambers, the combined water plane area of said auxiliary chambers exceeding the water plane area of the base at any other horizontal plane between the upper and lower stringer elements, said auxiliary buoyancy chambers having a total buoyancy to provide tons-per-inch immersion sufficient to prevent substantial vertical movement of said hull member under varying live loads, and means for ballasting and de-ballasting the several flotation chambers whereby to regulate the extent of submergence of said base in said water body.

2. A buoyant drilling rig base for afloat condition drilling, comprising, a hull member comprising a wave transparent structural frame defined by vertically spaced upper and lower stringer elements interconnected by hollow tubular bracing elements defining buoyancy elements and disposed in partly submerged floating position in a water body, the lower stringer elements and said bracing elements defining flotation chambers having displacement sufficient to support said base in said partially submerged floating position without rigid connection to the underlying land, a drill support mounted on said hull member, a plurality of auxiliary buoyancy chambers rigidly secured to said bracing elements at a uniform level intermediate the upper and lower stringer elements and partly sub-

merged in the water body, said auxiliary buoyancy chambers being of substantially lesser length than the vertical distance between said upper and lower stringer elements, each of said auxiliary buoyancy chambers having greater water plane area than the portions of said bracing elements extending above and below said auxiliary buoyancy chambers, the combined water plane area of said auxiliary chambers exceeding the water plane area of the base at any other horizontal plane between the upper and lower stringer elements, said auxiliary buoyancy chambers having a total buoyancy to provide tons-per-inch immersion sufficient to prevent substantial vertical movement of said hull member under varying live loads, the spatial arrangement of said auxiliary chambers being such that the center of flotation of the water plane area thereof is substantially coincident with said drill support, and means for ballasting and deballasting the several flotation chambers whereby to regulate the extent of submergence of said base in said water body.

3. A buoyant drilling rig base for afloat condition drilling, comprising, a plurality of elongate horizontally disposed hull members radiating in angular relation to each other from a common center section, a drill support mounted adjacent the center section in the angular area included between adjacent hull members, each of said hull members comprising a wave transparent structural frame defined by vertically spaced upper and lower stringer elements interconnected by hollow tubular bracing elements defining buoyancy elements and disposed in partly submerged floating position in a water body, the lower stringer elements and said bracing elements defining flotation chambers having displacement sufficient to support said base in said partially submerged floating position without rigid connection to the underlying land, a plurality of auxiliary buoyancy chambers rigidly secured to said bracing elements at a uniform level inter-

mediate the upper and lower stringer elements and partly submerged in the water body, said auxiliary buoyancy chambers being of substantially lesser length than the vertical distance between said upper and lower stringer elements, each of said auxiliary buoyancy chambers having greater water plane area than the portions of said bracing elements extending above and below said auxiliary buoyancy chambers, the combined water plane area of said auxiliary chambers exceeding the water plane area of the base at any other horizontal plane between the upper and lower stringer elements, said auxiliary buoyancy chambers having a total buoyancy to provide tons-per-inch immersion sufficient to prevent substantial vertical movement of said hull member under varying live loads, the spatial arrangement of said auxiliary chambers being such that the center of flotation of the water plane area thereof is substantially coincident with said drill support, and means for ballasting and de-ballasting the several flotation chambers whereby to regulate the extent of submergence of said base in said water body.

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