Feb. 24, 1942. G. A. McCAMMON 2,274,082

METHOD FOR CONSTRUCTION OF MARINE FOUNDATIONS

Filed Aug. 31, 1939 4 Sheets-Sheet 1

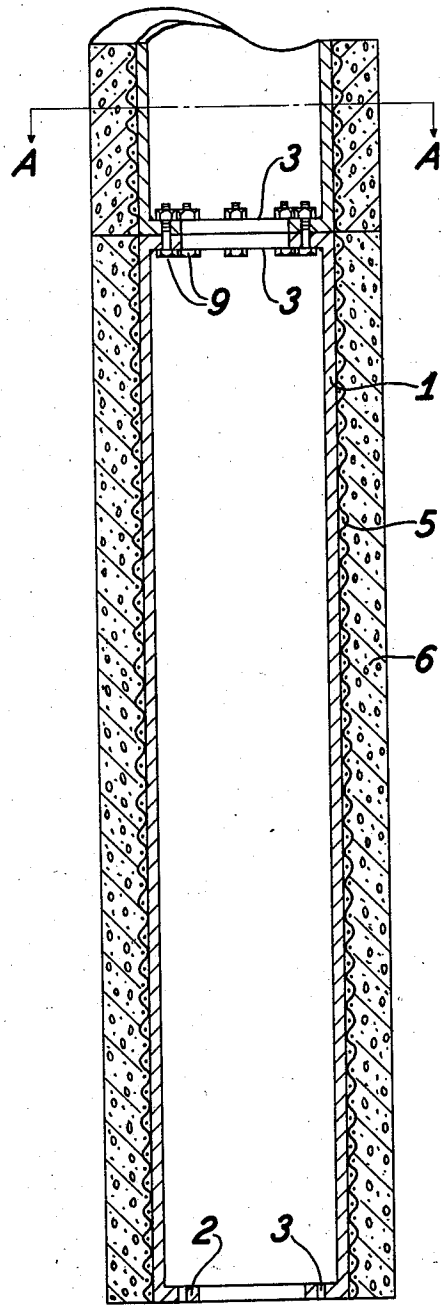

FIG_1_

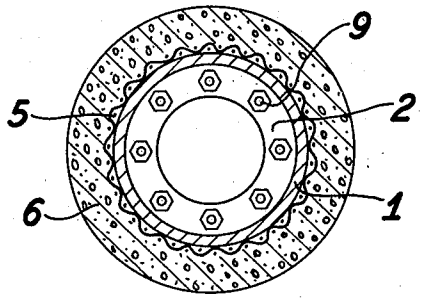

FIG_2_

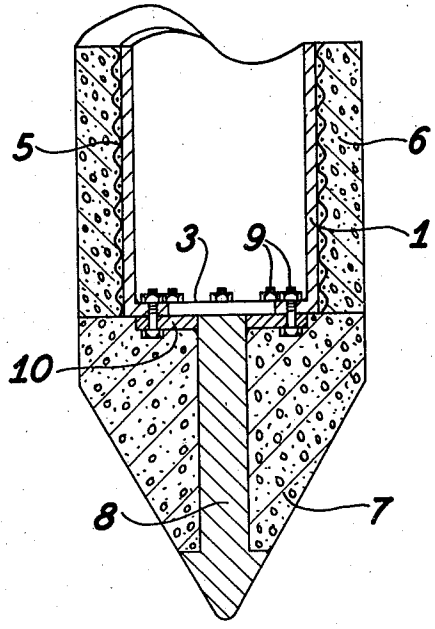

FIG_3_

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METHOD FOR CONSTRUCTION OF MARINE FOUNDATIONS

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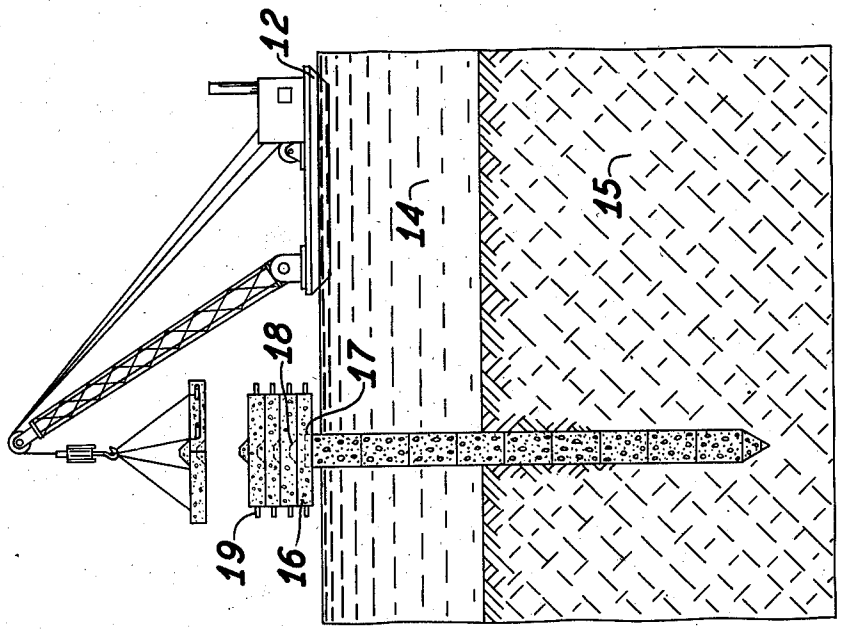

FIG_5_

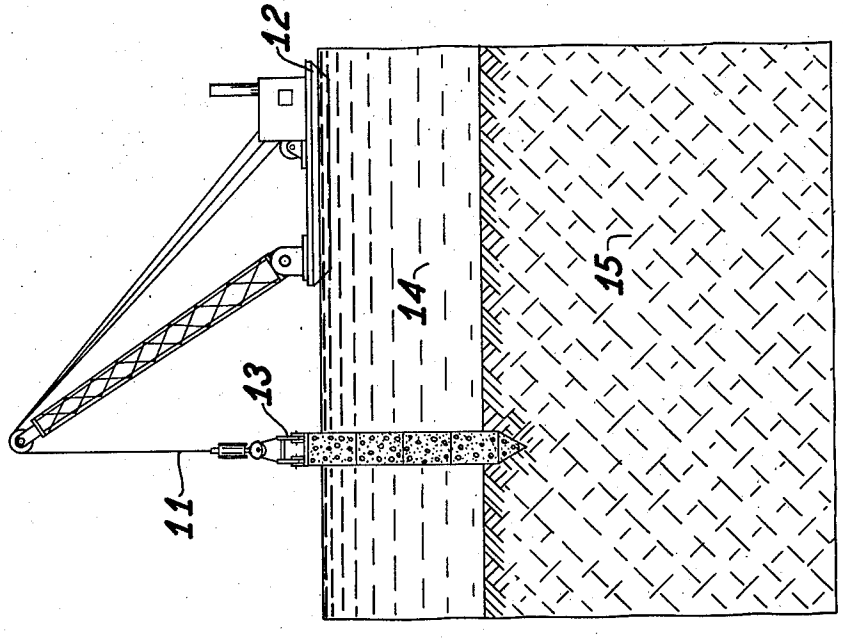

FIG_4_

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METHOD FOR CONSTRUCTION OF MARINE FOUNDATIONS

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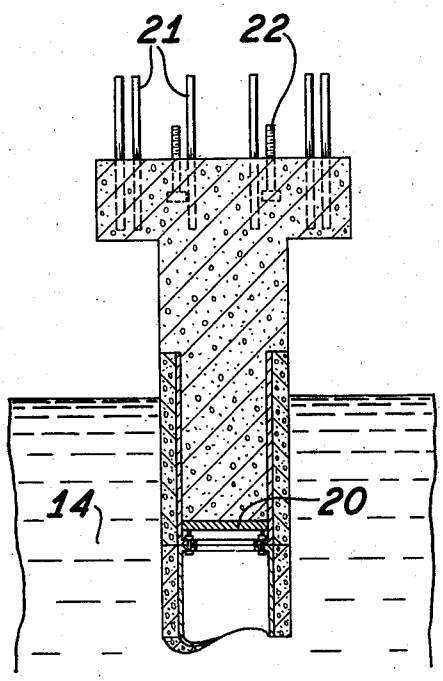

FIG_6_

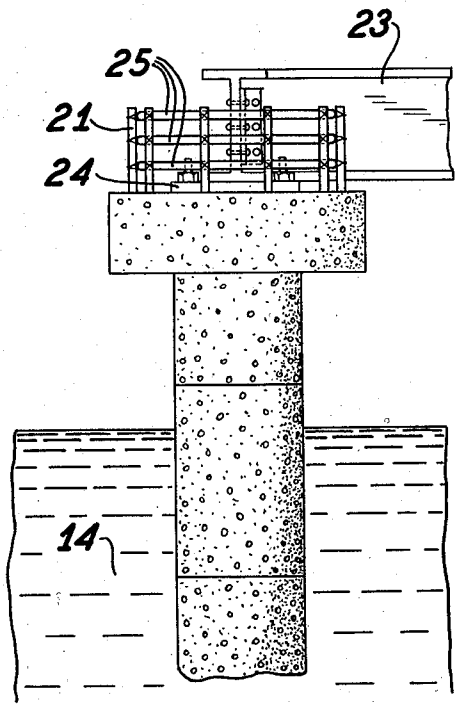

FIG_8_

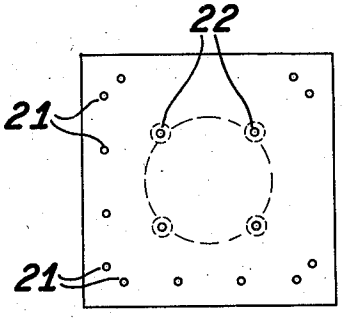

FIG_7_

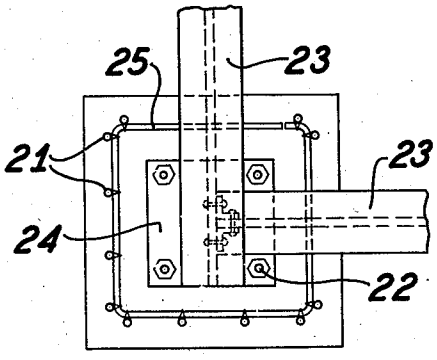

FIG_9_

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METHOD FOR CONSTRUCTION OF MARINE FOUNDATIONS

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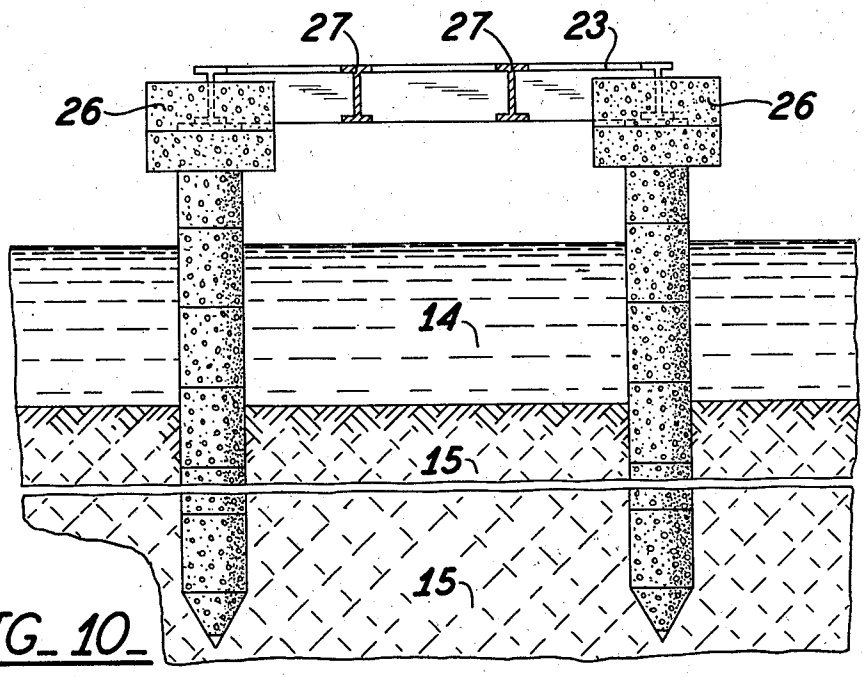

FIG_10_

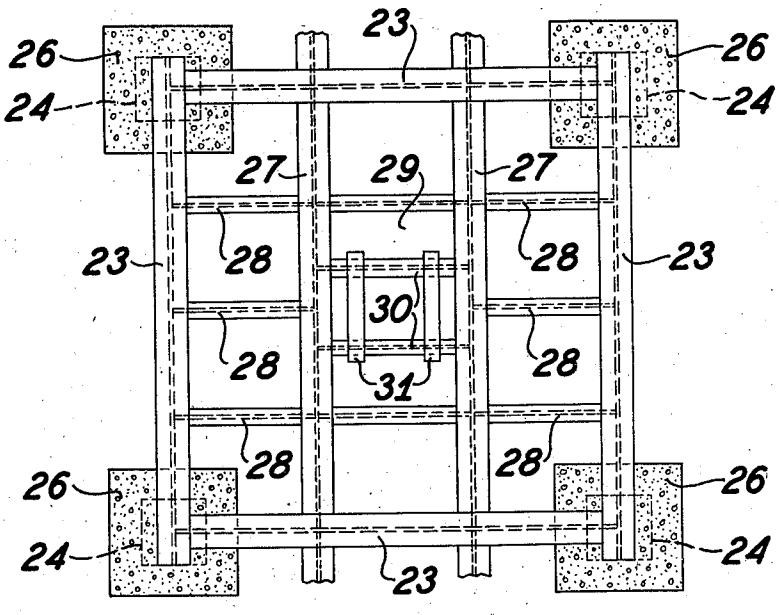

FIG_11_

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Patented Feb. 24, 1942 2,274,082

UNITED STATES PATENT OFFICE

2,274,082

METHOD FOR CONSTRUCTION OF MARINE FOUNDATIONS

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Application August 31, 1939, Serial No. 292,766

4 Claims. (Cl. 61—50)

The present invention is directed to a method for the erection of foundations for derricks in bodies of water, especially for the erection of drilling rigs for oil wells under bodies of water.

Since the advent of submarine drilling for oil several years ago, much thought has been given to ways and means for providing suitable foundations for the derricks which must be used for the drilling operations. In the past, only complicated structures have been devised and most of these were suitable for use only in shallow water. In all cases hitherto known it has been customary for the erection of derricks for submarine drilling to be extremely expensive, far out of proportion with relation to the actual amount of construction work involved to the erection of drilling rigs on land.

The principal object of the present invention is the provision of a method for the erection of structures in bodies of water for the aforesaid purpose which is at once simple, relatively inexpensive and productive of foundations of unusual stability and strength.

An ancillary object of the present invention is the provision of structural members suitable for use in the practice of the method of the present invention.

The present invention will be more clearly understood from the following detailed description of the accompanying drawings in which—

Figure 1 is a longitudinal section of a caisson or pile section for use in the present invention;

Figure 2 is a cross-section along the line A—A of Figure 1;

Figure 3 is a vertical section of a detail of the lowermost caisson of an assembly of such caissons;

Figure 4 is a front elevation of a barge in the act of setting a caisson or pile in place;

Figure 5 is a similar view showing the means and method used in forcing the caisson into the earth;

Figure 6 is a vertical section of a cap member shown in place on the caisson;

Figure 7 is a plan view of Figure 6;

Figure 8 is a front elevation of a completed support with the floor structure in place;

Figure 9 is a plan view of Figure 8;

Figure 10 is a side elevation of a completed foundation; and

Figure 11 is a plan view of Figure 10.

Referring to Figure 1 in detail, numeral 1 designates a metal cylinder having at its either end an inwardly directed flange 2 provided with bolt holes 3 and having its outer surface corrugated or provided with wire netting 5 to act as reinforcement and binding surface for a layer of concrete 6. In practice, the cylinder 1 is usually made from a flat piece of steel having one of its surfaces corrugated or provided with raised portions, such as those commonly found on safety treads. The flat sheet is rolled into a cylinder and welded, and the flanges are then welded in place. The metal cylinder is then placed in a mold of larger diameter concentric therewith, and the annular space between the cylinder and the mold is filled with concrete. A plurality of these cylinders can be readily aligned merely by bolting the adjacent flanges of adjacent sections together. The cylinders are usually of sufficient diameter to accommodate a workman.

As shown in Figure 3, a pointed nose 7 is provided for the section which is to be the bottom section of a group. This nose, as shown, is made of a core 8 of steel having a pointed end and having molded thereon a body of concrete. Before the concrete is set in place bolts 9 are placed in the holes of a disc 10 carried by the inner end of core 8.

In the practice of the present invention, a plurality of these sections are bolted together and are then loaded on a barge and carried out to location. The number of sections bolted together will generally be sufficient so that with the pointed end embedded in the bottom of the body of water, the uppermost section will protrude above the surface. On location the upper end of the string of sections is connected to the lifting cable 11 of the derrick mounted on the barge 12 by a suitable joint 13.

In Figure 4, numeral 14 designates a body of water and numeral 15 the earth beneath it. By manipulation of the derrick the assembled sections are raised to a vertical position and then lowered through the water to the earth beneath. During the lowering of the assembly it is held in an upright position by feeding in suitable quantities of water into its hollow interior.

In order to embed the pile or caisson in a self supporting manner in the earth beneath the water, it is generally necessary to spud it into place by virtue of its own weight. Alternatively, a nozzle may be provided in the lower end of the caisson and a suitable cavity formed in the earth by the jetting action of a pressure fluid ejected through the nozzle. Other ways of placing the caisson in an upright self-supporting position will occur to those skilled in the art.

After the assembled sections are placed in an

upright position, the bracket 13 is removed and another section is bolted in place on the upper end of the assembly. Then weights are added to the upper end of the assembly to force it into the ground. These weights are shown in Figure 5 and consist of square, flat blocks of concrete which may have any desired weight and are usually from ten to twenty tons apiece. The lowermost of these weights 16, is provided with a cylindrical recess 17 to receive the top of the uppermost caisson section, and on its upper face with a frustro-conical protuberance 18. Each of the next higher sections is provided with a seat for a frustro-conical protuberance on its lower face and with a frustro-conical protuberance on its upper face so that the successive weights can be nested one upon the other. Each of the weights is provided with protruding arms 19 which can be engaged by a lifting cable.

As the weights are added the assembled sections of the caisson are forced down into the earth until the upper end thereof approaches the water level. Then the weights are removed and another section is bolted into place and the weighting process repeated. This series of steps is repeated until the caisson or pile strikes a solid foundation.

The whole series of operations is repeated at each of four locations constituting the four corners of the foundation. In each case the driving and building operation is terminated with the uppermost section just above the water level. If, in some cases, this is impossible by reason of the unevenness of the bed rock, the inequality in height is taken care in the manner hereinafter specified.

In Figure 6 is shown a head member which is placed on each of the upright caissons or piles. This head member may be cast in place or may be precast and set in place. In the embodiment shown in Figure 6 the head member is cast in place. This is accomplished by placing an impervious plate 20 over the internal flange of the uppermost section of casing from the upper end of which the flange has been omitted or removed. A suitable form is then built up above the casing and concrete is poured into the form filling the uppermost section of the casing as well as the form. While the concrete is still soft, upright posts or metal rods 21 are set in place at the various corners and in between the corners, and bolts 22 are also set in place with their threaded ends upward in position to receive a bed plate for the flooring framework of the foundation.

From the above discussion it will be apparent that when the tops of the caisson are not at the same level, this difference in level can be compensated for by regulating the lengths of the caps of the respective caissons.

The flooring framework, as shown in Figures 8–11, consists of I-beams 23 suitably bolted together to form a square or rectangle as the case may be, and carrying at their corners a bed plate 24 provided with perforations to receive the bolts 22. This framework is set in place as a unit and the bed plates are bolted down. It will be noted that the upright rods 21 are so spaced as to permit the setting in place of the flooring. Reenforcing rods or wires, so-called stirrups, are then tied to the upright rods 21 as shown in Figures 8 and 9 and passed through the I-beams which are suitably perforated for this purpose. These rods are designated by numeral 25. When the stirruping operation is completed, a suitable form is built up about the head member and concrete is poured around the reenforcing members 21 and the rods 25, as well as the ends of the I-beams resting on the head member. This final concrete head 26 then embraces the corners of the floor members to form a solid unitary structure as shown in Figure 10.

As shown in Figure 11, the floor members 23 are provided with longitudinal cross-beams 27 and with transverse cross pieces 28. A central opening 29 is left between the longitudinal cross members and in this opening is arranged a pair of slidable cross pieces 30 which are connected together by a pair of slidable longitudinal members 31. The members 30 and 31 are adapted to carry the conventional rotary table of a drilling rig and are made adjustable in both directions so as to facilitate the centering of the rotary table above the point where it is desired to drill. In practice, a folding steel plate cover with suitable apertures and trap doors is laid on the beam members constituting the flooring supports.

The longitudinal cross members 27 extend on either side of the main members 23 so as to form a cantilever structure, that is, a main floor member with side bridges on either side thereof. These side bridges carry auxiliary drilling equipment such as the pumps and boilers and the like. This particular arrangement lends to great stability and convenience in operation.

It will be apparent that many changes may be made in the aforedescribed methods and structural elements without departing from the scope of the present invention. It may be mentioned here that the leg members are filled with water before the caps are set in place. As previously pointed out, the cap members instead of being cast in place may be precast on shore in the shape shown in Figure 6 and merely set in place. In this case, the joint between the caps and the uppermost section of the leg member is reenforced by wrapping it with strips of steel. It will also be understood that the particular form of floor supporting the structure shown in Figure 11 is not essential to the general method or combination of the present invention and may be modified without departing from the scope thereof.

The nature and objects of the present invention having been thus described and illustrated, what is claimed as new and useful and is desired to be secured by Letters Patent is:

1. A method for erecting a floor over a body of water which comprises assembling a plurality of hollow sections end to end to form a pile-like member, setting said assembly in an upright position in the body of water with its lower end embedded in the earth below water and its upper end protruding above the water, adding an additional section to the upper end of said pile-like member, adding successive nesting weights to the upper end of said added section until said pile-like member is forced into the earth a distance substantially corresponding to the length of said added section, removing said weights, adding another section to said pile-like member, and repeating operations until said pile-like member rests on a solid foundation, setting other pile-like members in a similar manner in an erect position spaced from said first pile-like member, and laying a floor on the upper ends of the pile-like members so arranged.

2. A method according to claim 1 in which the assembly is maintained in an upright position during the setting operation by adjusting its

buoyancy by the addition of water into its hollow interior.

3. A method according to claim 1 including the steps of fixing to the top of each pile member a cap member provided with spaced rods extending upwardly from its upper surface, setting beams between the pile-like members with their ends within the space defined by said rods, binding the ends of said beams to said rods and casting concrete around said rods and the ends of said beams.

4. A method for sinking a pile into the earth beneath a body of water which comprises disposing the pile in an upright position with its bottom end engaging the earth beneath the body of water and with its upper end extending above the surface of the water and superimposing directly on the exposed upper end of the pile by means of a hoist a succession of self-centering weighting members provided with means for preventing relative lateral movement thereof with respect to each other sufficient in number to drive the pile into the earth the desired distance and then removing the weights from the top of said pile.

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