July 7, 1970 G. W. PERRY 3,518,835

METHOD FOR ALLEVIATING SCOURING ABOUT A MARINE STRUCTURE

Filed July 15, 1968

FIG. 2

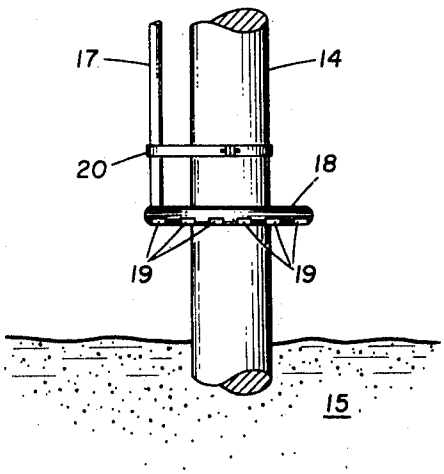


FIG. 1

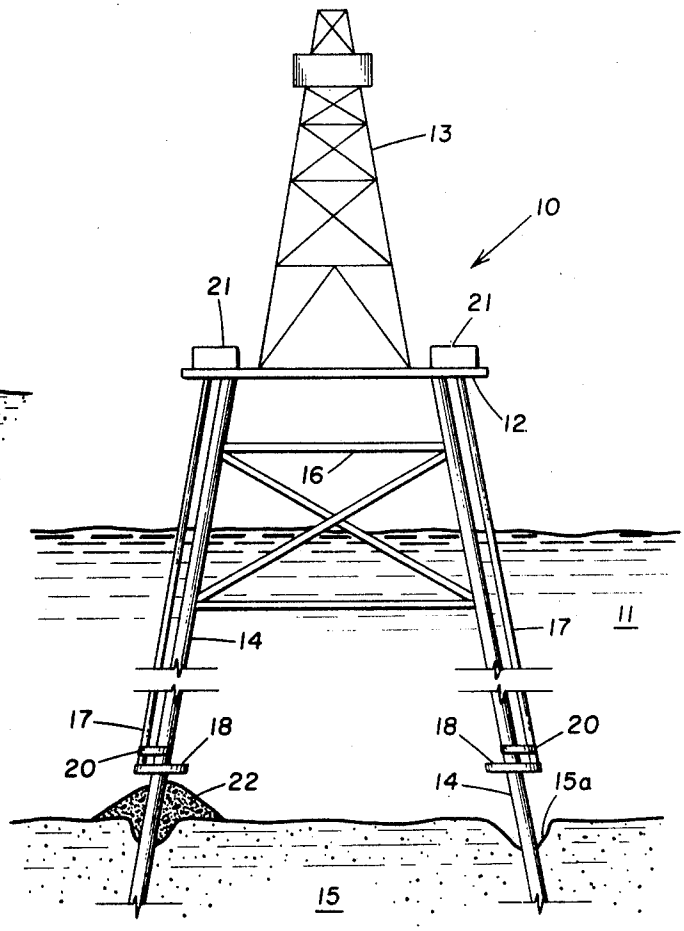
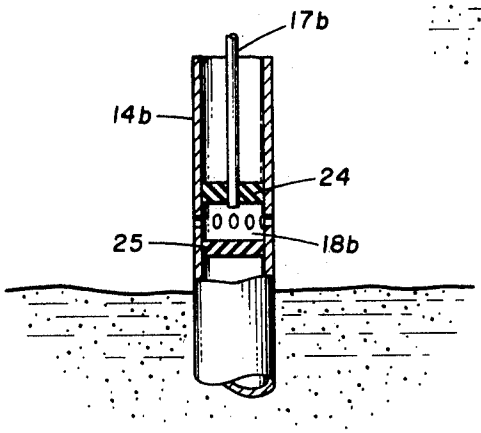


FIG. 3



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United States Patent Office 3,518,835 Patented July 7, 1970

3,518,835

METHOD FOR ALLEVIATING SCOURING ABOUT A MARINE STRUCTURE

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Filed July 15, 1968, Ser. No. 744,993
Int. Cl. E02d 3/14
U.S. Cl. 61—46 8 Claims

ABSTRACT OF THE DISCLOSURE

This specification discloses:

A method for alleviating scouring around the legs of a marine structure which are partially embedded in the bottom of a body of water. The method comprises the placement of an insoluble, unconsolidated, particulate, antiscouring material having a specific gravity of four or greater in masses about the lower ends of each leg. The antiscouring material is preferably selected from materials which are normally used for weighting drilling muds, e.g., iron oxide, lead shot, celestite, and barite. Of these, barite is preferred due to its ready availability and relatively low cost. This material by having substantially greater density than that of the naturally occurring materials which normally comprise the bottom of the water will resist scouring and will fill any excavations caused by scouring of sand or gravel from the legs. It will thereby maintain a firm foundation about the legs and prevent shifting of the structure.

BACKGROUND OF THE INVENTION

This invention relates to a method of alleviating scouring about the legs of a marine structure.

The drilling of underwater wells in search of oil or other minerals is now commonplace. In carrying out such drilling operations, different types of marine structures are used depending primarily upon the depth of the water encountered. In depths of water between 40 and 300 feet, the marine structure is usually one that has a work platform supported on legs which in turn are embedded in or rest on the bottom of the body of water. This structure could be one which is assembled in place by embedding the legs of a ready-made substructure into the bottom and then assembling the platform on the embedded legs or, as is most often the case, is a structure which is commonly referred to in the art as a "jack-up" or "submersible" rig.

A typical jack-up rig is comprised of a floating barge or work platform on which is carried the drilling derrick, draw works, mud tanks and pumps, and the other associated equipment necessary for the actual drilling of an underwater well. Spaced about the periphery of the platform and extending through openings or guides thereon are a plurality of legs. These legs are normally retracted and supported in a position above the platform whenever the rig is floated from one location to another. Once the rig has been positioned over the desired drilling site, each leg is lowered through its respective platform opening or guide until it engages the bottom of the water where it partially embeds itself in the soil. In some instances, a "spud can" can be provided at the lower end of each leg to aid in embedding the legs in the bottom. When each leg is in its desired position on the bottom, jacks on the rig are actuated to lift the platform out of the water and onto the legs. Whether the structure is a jack-up rig or one which rests on the bottom, or which is assembled at the drilling site, the work platform will be supported above the surface of the water on legs which are effectively anchored to the bottom of the water and accordingly will normally provide a stable base for drilling operations.

Unfortunately, however, in some bodies of water the platform does not remain stable due to the "scouring" of

soil from around the embedded portions of the legs. This scouring, which is believed to be caused by tides, waves, and/or strong underwater currents, may shift or move large volumes of sand, gravel, or other materials from around the legs in relatively short periods of time. This undermining of the legs allows one or more of said legs to shift or sink further into the bottom, thereby causing the platform to tilt or shift which in turn may bend the drilling assembly, dislodge valuable equipment, or destroy the platform itself. In view of this, it is obvious that the problem of scouring is one which must be considered when jack-up or submersible rigs or like structures are used in offshore operations.

In the past, various approaches have been taken to prevent scouring of soil from about the legs of such structures. These approaches have included, for example, (1) using the rigid barriers around the legs, such as steel pilings or scouring skirts; (2) consolidating the soil around the legs by use of hardening resins, concrete, or other soil solidifying material; and (3) surrounding the exposed areas of the legs on the bottom with masses of unconsolidated, insoluble, antiscouring material or objects, such as large size gravel, concrete blocks, anchored willow mats, or sandbags.

Of these approaches, the latter one of using masses of unconsolidated material or objects to surround the lower ends of the legs is one of the most commonly used. This antiscouring material or objects being unconsolidated have a tendency to fall into any undermining or excavations caused by scouring, thereby maintaining a relatively firm foundation around the legs and preventing any serious shift of the legs. Also, by using unconsolidated material or objects instead of material which solidifies around the legs, the rig can be moved more easily at completion of the drilling operation.

Large unconsolidated, antiscouring objects, such as sandbags, have been found to work well in preventing scouring about the legs of a marine structure. However, due to their bulk, the placement of such objects requires many hours of divers' time and accordingly is both time consuming and expensive. Furthermore, these objects are not commonly available on a drilling structure and must be transported to the drilling site for the sole purpose of providing antiscouring material which again adds to the expense incurred. Smaller unconsolidated material, such as gravel and sand, is much easier to position and requires less time than the larger objects, but this material, being substantially the same material which naturally makes up the bottom of the body of water, will not resist scouring any better than the naturally occuring material. Accordingly, masses or mounds of such material around the legs merely delay the detrimental effects of scouring rather than substantially alleviating it.

BRIEF SUMMARY OF THE INVENTION

The present invention provides a new and improved method for alleviating scouring about the legs of a marine structure in which unconsolidated material is massed around the legs but one which overcomes many of the disadvantages previously encountered in such antiscouring procedures. The present method utilizes an insoluble, unconsolidated, antiscouring material having a specific gravity of four or greater, which is substantially heavier than the material naturally occurring on the bottom of the body of water in which the legs are embedded, e.g., sand and gravel have a specific gravity of around two. This material with its greater density readily resists scouring and will inherently fall into any undermining or excavations created by the scouring of sand or gravel from around the legs or from beneath the antiscouring material itself, thereby maintaining a firm foundation around the legs at all times.

The antiscouring material can be any insoluble, unconsolidated material having a specific gravity of four or greater, but is preferably from the class of materials which are commonly used to increase the density of drilling mud, e.g., barite. Barite, which has a specific gravity of 4.3 to 4.6, is usually available on a drilling rig and eliminates the need for special trips to a marine drilling structure for the sole purpose of providing antiscouring material. Also, barite can easily be pumped through a conduit or the like which allows it to be positioned about the legs with a minimum of time and expense. A conduit can be attached to each leg or the leg itself can be used as a conduit, if it is hollow, to place the material in its desired position as will be more fully explained below. Other common weighting agents which can be used are iron oxide, lead shot (galena), and celestite.

BRIEF DESCRIPTION OF THE DRAWINGS

The actual construction, operation, and the apparent advantages of the invention will be better understood by referring to the drawings in which like numerals identify like parts and in which:

FIG. 1 is a schematic elevational view of a marine structure incorporating the present invention;

FIG. 2 is an elevational view of apparatus which can be used in the practice of the present invention; and

FIG. 3 is an elevational view of another apparatus which can be used in the practice of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A marine structure utilizing the present invention is schematically shown in FIG. 1 and is to be considered as illustrative only and not limiting as to the types of marine structures in which the method may be used. Structure **10** is shown in an operable position in a body of water **11** and is comprised of a work platform **12** having a drilling derrick **13** and other associated drilling equipment (not shown) thereon. Platform **12** is supported above the surface of the water by means of a plurality of legs **14** which extend through the water and the lower ends of which are embedded in or on the bottom **15** of the body of water **11**. The legs **14** are shown as singular tubular members but could be of different construction, as will be more fully explained below. Cross bracing **16** joins legs **14** together to give structural integrity to structure **10** as is well known in the art.

A conduit **17** is provided for each leg **14** and extends along the leg from platform **12** to a manifold **18** which is located near the bottom **15**, said conduits being secured to the legs by means of clamps **20** prior to the positioning of leg **14** in their operable position on bottom **15**. As more clearly seen in FIG. 2, manifold **18** encircles leg **14** near its lower end and has a plurality of openings **19** spaced around the underside thereof. Pumps **21** on platform **12** (FIG. 1) are connected to respective conduits **17** and are adapted to force particulate material through said conduits to manifolds **18** and hence out openings **19** onto bottom **15** around legs **14**.

In operation, marine structure **10** is positioned at a desired site with the legs **14** embedded in bottom **15**. As explained above, conduits **17** and manifolds **18** are attached to legs **14** prior to their placement in the water. Under normal conditions, if no provisions are made to prevent or alleviate scouring, soil from around the legs will wash or scour away leaving an excavation **15***a* which in turn may allow the structure to shift. In accordance with the present invention, once structure **10** is in place, an insoluble, unconsolidated, particulate, antiscouring material is pumped down conduits **17** and through openings **19** in manifolds **18** to form masses **22** of said material about legs **14**. The antiscouring material can be any insoluble, unconsolidated, particulate material having a specific gravity of four or greater but is preferably selected from those materials normally used for weighting muds. Examples of such materials are iron oxide, lead shot (galena), celestite, and preferably barite due to its ready availability and relatively low cost. These materials are illustrative only and are not to be considered limiting. This material by having substantially greater density than that of the naturally occurring materials which normally comprise the bottom of the water will readily resist scouring and will inherently fall into any undermining or excavations created by scouring around the legs or from beneath the mass **22** itself. This maintains a firm foundation around legs **14** and prevents shifting of the legs. Also, since the particulate material does not consolidate, structure **10** can be moved more easily when operations are completed.

It should be recognized that the manner or apparatus used to place the antiscouring material forms no part of the present invention and can comprise any means which adequately positions a heap of said material around the legs. For example, FIG. 3 discloses a different apparatus which can be used to place the desired material around leg **14***b* whenever the leg is hollow. Conduit **17***b* extends from platform **12** through leg **14***b* to a manifold **18***b* which is formed in leg **14***b* between packer means **24**, **25**, respectively. Openings **19***b* are provided in leg **14***b* to allow material to flow from manifold **18***b* to a position around the exterior of leg **14***b*.

Also, as discussed briefly above, the present invention is not restricted to alleviating scouring about marine structures having legs formed of singular tubular members but can be used equally as well with structures having skeletal legs, e.g., jack-up rigs or large diameter caissons or footings or mats of submersible rigs. Skeletal legs are well known in the art as those which are individually formed from a plurality of tubular members joined together by cross bracing. It should be apparent that each tubular member in a skeletal leg could easily be equipped with a conduit **17** and manifold **18** so that a mass **22** of the antiscouring material could be placed about each tubular member of each skeletal leg, thereby alleviating scouring about the embedded portion of the skeletal leg. Further, if a spud can is used at the lower end of a skeletal leg, it would be a simple matter to extend a manifold around the periphery thereof so that antiscouring material could be massed about the embedded portion of the spud can.

Although particular embodiments of the subject invention have been described, the disclosure is intended to cover all changes and modifications therein which do not constitute departure from the spirit and scope of the invention.

What is claimed is:

1. A method of alleviating scouring around the legs of a marine structure wherein the lower ends of said legs are partially embedded in or resting on the bottom of a body of water and the upper ends of which support a platform comprising:

placing a mass of an insoluble, unconsolidated, particulate, antiscouring material having a specific gravity of four or greater on the bottom of said body of water around the lower end of each leg.

2. The method set forth in claim **1** wherein:

said material is an insoluble, unconsolidated, particulate material having a specific gravity of four or greater from the class of materials normally used for weighting drilling mud.

3. The method set forth in claim **2** wherein:

said material is barite.

4. The method set forth in claim **2** wherein:

said material is iron oxide.

5. The method set forth in claim **2** wherein:

said material is lead shot.

6. The method set forth in claim **2** wherein:

said material is celestite.

7. A method of alleviating scouring around the legs of a marine structure comprising:

positioning the lower ends of said legs in or on the bottom of a body of water; and

placing a mass of an insoluble, unconsolidated, particulate, antiscouring material having a specific gravity of four or greater on the bottom of said body of water around the lower ends of said legs after said legs are in place.

8. The method set forth in claim 7 wherein:

said material is barite.

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