

[54] METHOD AND APPARATUS FOR
INSERTING CYLINDRICAL PILING

[75] Inventor: Michael G. Hogan, Metairie, La.

[73] Assignee: Texaco Inc., New York, N.Y.

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61/53.7, 63; 175/21, 20

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Primary Examiner—Louis K. Rimrodt

Assistant Examiner—Philip C. Kannan

Attorney, Agent, or Firm—T. H. Whaley; C. G. Reis

[57] ABSTRACT

The invention relates to a method and apparatus for effectively driving cylindrical piling into a substratum or soil having a consistency that would otherwise tend to plug the pile. The method consists of driving the pile, and constricting the compacted earthen plug at the lower end thereof. High pressure streams of fluid are then introduced at the pile lower end in a direction to erode, and break up the plug to prevent the latter from adhering to the pile walls. The disturbed fluidic mass at the pile lower end can then be removed or at least be rendered into a condition where it will not plug the pile.

The apparatus comprises a cylindrical, metallic walled pipe. The lower end of the latter includes an annular shoe depending therefrom and having a constricted passage therein defined by a gradually tapering profile. A manifold formed in the shoe receives a high pressured fluid such as water, and directs the same through a plurality of orifices toward both the pile wall, and the confined plug.

7 Claims, 4 Drawing Figures

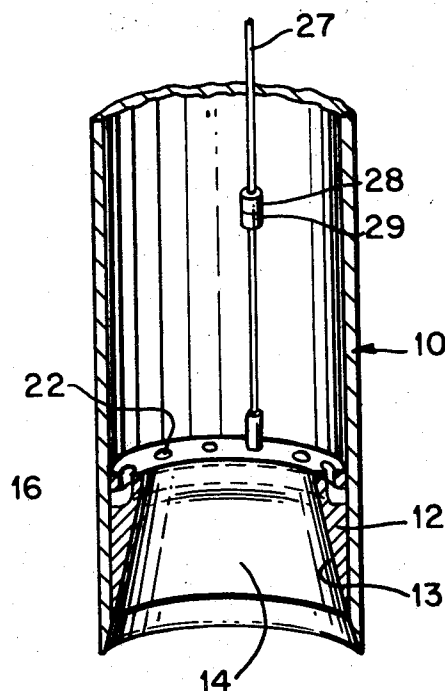


FIG. 3

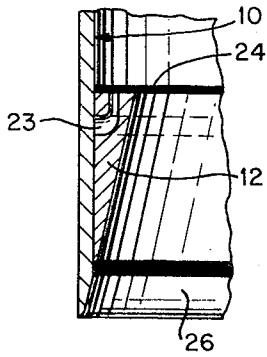


FIG. 4

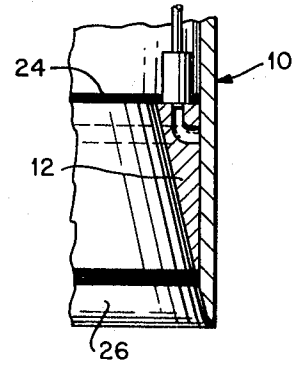


FIG. 1

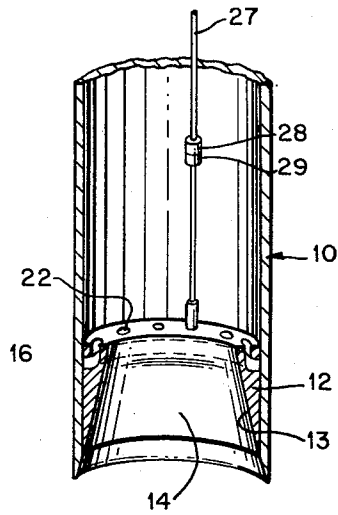
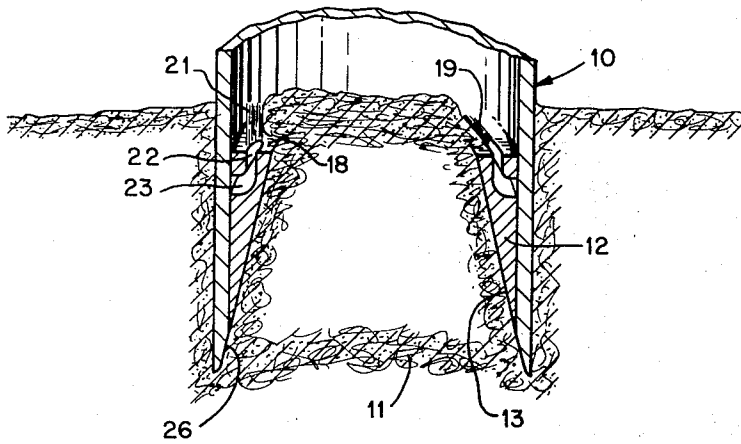


FIG. 2



METHOD AND APPARATUS FOR INSERTING CYLINDRICAL PILING

BACKGROUND OF THE INVENTION

In the setting of piling for foundations or other means a common pile form of structure utilizes a cylindrical pipe or the like. The latter can vary in diameter from a few inches to several feet depending on the size and weight of structure to be supported. Such piling is common in both onshore and offshore construction wherever the subsoil is of such consistency as to necessitate the use of piling.

Normally, in setting piling of the type contemplated, sections of the pile are sequentially added to the top end of the unit as the latter is driven into the subsoil. Driving normally continues until the point of refusal. At this point, the friction of the soil against the pile walls is sufficient to prohibit the latter from further downward movement and consequently it is deemed adequate as a foundation member.

In utilizing such a pile form however, as the latter enters the substratum a core or earthen plug will be formed in the pile center. For certain soils and conditions, such a plug will have a tendency to act as a deterrent for further entry of the pile since it also engages the pile inner walls and affords a backward drag as the latter is driven downwardly.

It is desirable therefore, in order to properly set the pile to a predetermined depth, that the interior earthen plug be dissolved, broken up, or otherwise disposed of. The latter operation is often achieved by inserting a suitable jetting apparatus into the pile interior, and by the use of high pressure nozzles and the like break up the plug and withdraw the same or permit it to remain in a condition as such that it will not adhere to the pile walls.

To break up a soil plug in this manner, however, it is first necessary to discontinue the piling operation. Concurrently though, the presence of a plug within the pile center tends to slow down said operation to the point where the driving unit is not functioning at its optimum point of efficiency. In either instance, the presence of the continuously building plug in the pile is both wasteful, inefficient, and deters the actual piling operation.

Said plug is considered wasteful in that its presence necessitates periodic interruption of the piling operation. Further, in the instance of offshore piling, the use of floating barges or the like represents a relatively large cost on a daily basis such that the actual stoppage of the unit cannot for long be tolerated.

Toward expediting the insertion of cylindrical piling of the type herein described, the present method and apparatus provides a means whereby the plug which is normally formed within a pile center is disintegrated to prohibit formation thereof as the pile progresses downwardly. Said method comprises the steps of lowering the pile into the substratum at a desired rate depending on the downward force of the driving element.

Simultaneously, jets of fluid such as water are directed from the lower end of the pile inwardly and upwardly thereof in a manner to break up and disperse any formation of soil which would prompt initiation of a plug, and which would tend to adhere to the pile inner walls.

The apparatus for achieving said embedding method includes a cylindrical shoe which is fastened internally within the lower end of an elongated pile. An annular manifold incorporated into said shoe is provided with a plurality of diversely directed discharge nozzles. The shoe is communicated with a source of a high pressure fluid such as water. The latter is forced downwardly through a conduit and into the shoe whereby it is discharged through the said nozzles at a high rate of speed. The plurality of circularly arranged water jets thereafter erode away and break up any soil plugs or earthen mass which might tend to form adjacent the pile wall. Further, should the plug not be disintegrated, the water functions in the capacity of a lubricant to minimize back drag.

DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. 1 illustrates a vertical cross sectional view of the present pile.

FIG. 2 is a segmentary view of an enlarged scale, illustrating the lower end of the pile as it enters a substratum.

FIGS. 3 and 4 are segmentary views of FIG. 2 illustrating the water carrying manifold.

Referring to FIGS. 1 and 2, a pile 10 of the type contemplated is illustrated, which includes an elongated cylindrical section disposed in a generally upright disposition as it is driven into a substratum.

Normally, the earthen plug 1 toward which the present invention is directed, consists of a sandy type soil which will, as the cylindrical pile is urged down into it, tend to form the herein mentioned compacted mass.

Normally, and as mentioned, pile 10 comprises a series of individual segments which are sequentially end welded one to the other as the piling operation progresses downwardly. Welding of the respective segments is done as the pile is lowered or urged into the soil. Further, said connection is achieved by positioning an upper pile segment adjacent the upper end of the inserted pile, and peripherally welding the two members at a solid joint.

In the instance of offshore piling, the pile would be at least partially filled with water depending on the degree of water leakage through the lower end thereof. In an onshore installation a similar situation would prevail depending on the degree of water contained in the soil.

While the pile unit can be urged downwardly at any desired degree of offset within limits into the substratum, it is presently shown disposed in a vertical orientation. Thus, as the pile is suspended at the upper end, the downward end will assume the proper vertical orientation. The normal pile member, is formed of a cylindrical, metallic walled unit such as steel pipe. The latter can vary from several inches to several feet in diameter. For ease of entry, the lower edge of pile 10 can be provided with a formed or contoured driving end such as to more readily enter the substratum.

As shown, the pile 10 lower end is provided with a shoe 12. The latter comprises an open ended cylindrical section, having a diameter compatible with the inside diameter of the pile. The inner surface of shoe 12 however, is formed with a tapered wall 13 to define a generally frusto conical passage 14 through which the compacted soil or plug will pass upwardly. Said inner surface 13, is provided with a smoothly tapered wall

which decreases from a maximum at the shoe lower end, or inlet 17 to a constricted minimum cross section at the shoe collar 16. Collar 16 in turn defines an annular ring or rim 18 which is normal to and coaxially with the inner wall of pile 10.

Referring to FIG. 1, said shoe 12 as mentioned, includes peripheral collar 16 having an outer edge which firmly engages, preferably by welding, to the lower edge of pile 10. The longitudinal positioning of said shoe 12 is such as to be adjacent to, although not necessarily at the absolute end of the pile. The primary function of shoe 12 is to receive the soil passing through the lower end of the pile, and as the latter is urged down, to compact plug 11 within the tapering walls of passage 14.

Referring to FIG. 2, as the pile 10 continues to be lowered, plug 11 which has been urged inwardly by the tapered collar walls, passes upwardly beyond the rim 18. When so positioned, the plug will be acted on by a plurality of peripherally arranged pressurized liquid jet streams 19 and 20 urged against the plug.

The respective discharge jets or orifices 22 are arranged in spaced apart relationship at annular rim 18, which is disposed concentrically with the pile 10 inner wall. Said rim 18 comprises an annular surface disposed substantially transversely of and normal to the pile longitudinal axis.

A groove formed in the peripheral surface of the collar 16 defines a manifold 23 for holding the jetting fluid, such as water. Said groove or manifold 23, when disposed contiguous with the pile 10 inner wall, forms a substantially water tight annular chamber about the collar. Shoe 12 is firmly held in place within pile 10 by an upper bead weld 24 which seals the shoe upper end to the pile wall. In a similar manner a bead 26 formed about the lower end of shoe 12 forms a second annular seal.

Thus, water which is urged under pressure into manifold 23 by an elongated pipe or conduit 27, enters the circular manifold 23 still under pressure. It is thereafter propelled from the respective orifice ports 22. As shown in FIG. 2, the diversely arranged water jets 22 will tend to erode away the sides of the centrally formed plug 11 thereby causing the soil to be broken away and swirled about. Said action will further prohibit engagement of the plug with the pile inner surface by in effect lubricating the pile wall. Thus, at least some of said jets 22 are directed along the pile inner surface to deter the possibility of soil clinging thereto.

The recessed disposition of rim 18 of course is such as to maintain an annular cavity about the face of the respective jet openings 22 even at such time as no water is being directed therefrom. Said positioning of jets 22 further reduces the possibility of the respective discharge nozzles becoming plugged due to the pressure of the soil thereagainst.

Referring to FIG. 1, liquid or water carrying conduit 27 is positioned adjacent the wall of pile 10, and extends longitudinally through the latter. Shoe 12 can be provided with any number of such water carrying conduits in accordance with the consistency of the soil into which penetration is to be made and the pile diameter.

The respective conduits 27 are fluid tightly fastened at the lower end thereof to collar 16, whereby to communicate with internal manifold 23. The pipe or conduit 27 can be fastened against the adjacent wall of pile

10 at spaced intervals to best deliver pressurized water to the shoe manifold. Each end of the respective conduit segments is provided with an end coupling 28 and 29 whereby to readily engage the end of a corresponding member. Thus, as the respective pile segments 10 are attached one to the other, a corresponding length of liquid conduits 27 will be similarly fastened.

The structure of the mating coupling parts 28 and 29 is such that they will form into tight sealing engagement. As shown in FIG. 1, each conduit is so positioned such that the coupling member is below the upper rim of the pile. Thus, when a pile segment is welded to the pile upper end, the coupling segment will not be in a position to be damaged. Thereafter, subsequent to the welding operation, a conduit section 27 is lowered onto and engaged with the lower segment.

Normally the embedded portion of a pile is not salvaged subsequent to having outlived its usefulness in a particular installation. It is, however, desirable particularly in the instance of deep water, to salvage the pile or any portion thereof which might be available. Consequently the pile 10 can be provided with an explosive ring either internally or externally should it be cut near the mud line. Fluid carrying conduit 27 may similarly be provided with a shattering device such as an explosive pack which is prepositioned on said member such that it can be withdrawn subsequent to the embedding operation.

Other modifications and variations of the invention as hereinbefore set forth can be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. An elongated anchoring pile adapted to be driven into a penetrable substratum for a sufficient depth to be firmly embedded in the latter, which comprises;
 - a. a cylindrical pile having a lower edge, and a uniform thickness wall extending substantially the length thereof,
 - b. a driving shoe carried adjacent to the pile lower end,
 - c. said driving shoe including an annular soil compacting surface spaced longitudinally from said lower end and terminating in a constricted annular collar, the latter having a set back rim extending from the constricted section to the pile inner wall,
 - d. a plurality of discharge nozzles formed in said annular collar being communicated with a high pressure source of liquid.
2. In an elongated anchoring pile as defined in claim 1, wherein said discharge nozzles open onto said set-back rim and being directed radially therefrom.
3. In an elongated anchoring pile as defined in claim 1, wherein said respective discharge nozzles are disposed generally circumferentially about said rim.
4. In an elongated anchoring pile as defined in claim 3, including; conduit means communicated with said collar and with said high pressure source of liquid to form a high pressure source thereof in said manifold.
5. In an elongated anchoring pile as defined in claim 4, wherein said conduit includes; a plurality of conduit segments being detachably connected one to the other along the inner wall of said pile.
6. Method for embedding a cylindrical pile having an interior wall into a substratum, the latter being charac-

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terized by a propensity to compact within the pile interior and thereby form an earthen plug which hampers downward progress of the pile, which method includes the steps of;

- a. providing water jetting means at the pile lower end, 5 having water jets therein,
- b. urging said pile downwardly into the substrate whereby to form said earthen plug at the pile interior,
- c. injecting a high pressure stream of water into said 10 earthen plug, a portion of said high pressure stream being directed upwardly along said pile inner wall,

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whereby to disperse the constituents of the plug, d. repeating steps (b) and (c) in sequence as said pile is further embedded.

7. In the method as defined in claim 6, including the steps of;

- a. gradually compacting said earthen plug to form a constricted portion in the latter, and
- b. injecting said high pressure water stream along 15 said pile inner wall at a point immediately adjacent to the plug constricted portion.

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