Dec. 6, 1966 A. L. GUY 3,289,420

METHOD FOR DRIVING PILES

Filed March 18, 1964 2 Sheets-Sheet 1

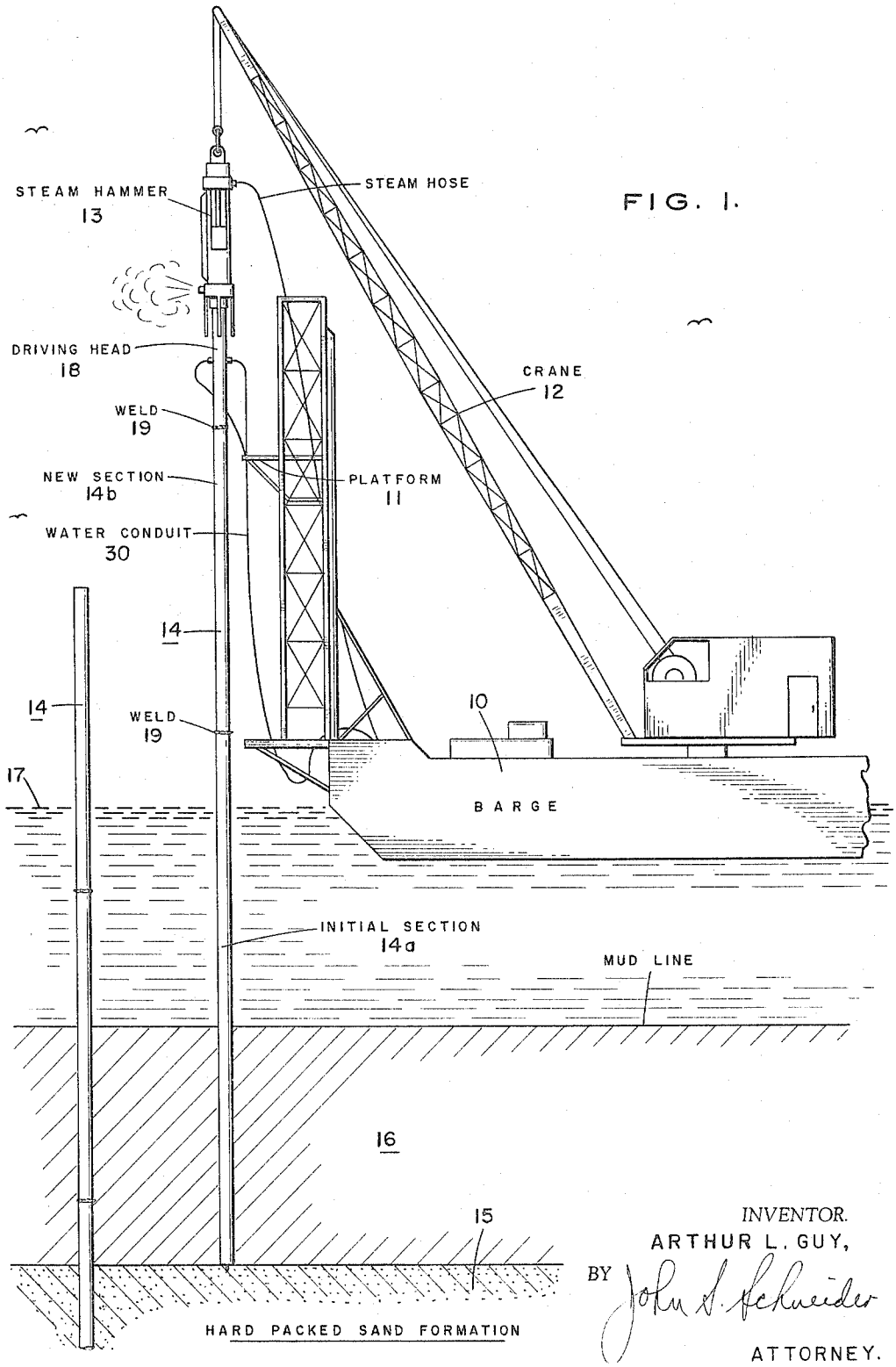


FIG. 1.

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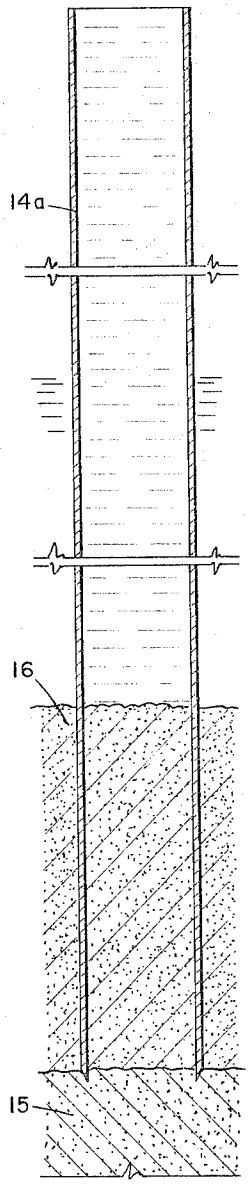


FIG. 2.

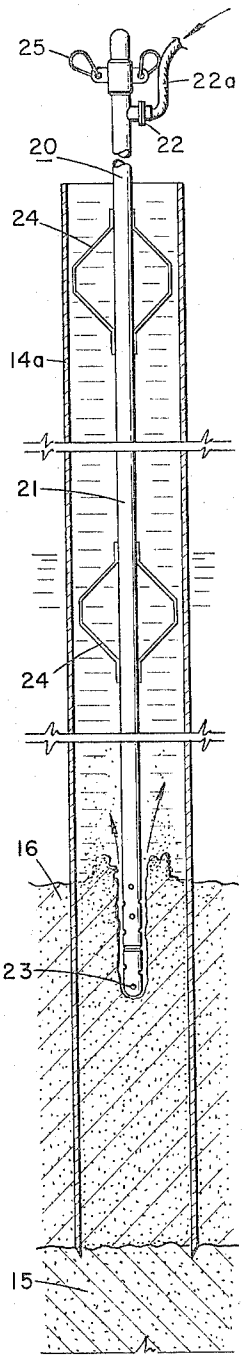


FIG. 3.

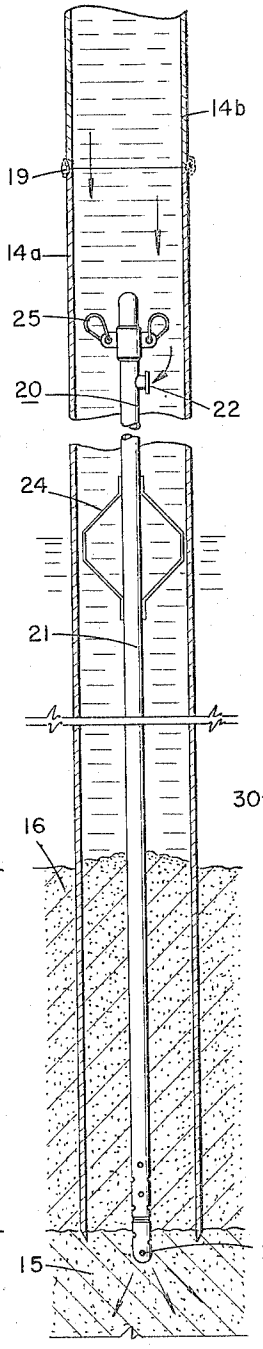


FIG. 4.

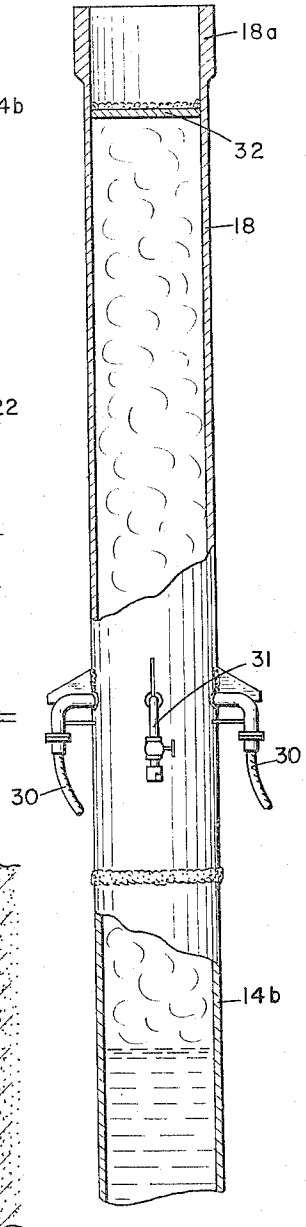


FIG. 4A.

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METHOD FOR DRIVING PILES

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4 Claims. (Cl. 61—53.5)

The present invention generally concerns the construction of drilling platforms and particularly concerns the manner of forming foundations for such drilling platforms.

In driving piles, especially those to be used to carry offshore drilling structures, by ordinary hammer means adequate pile penetrations cannot be achieved in dense sands because of the great build-up of end bearing on the piles in the sand formation. Pile driving in such sands often results in premature refusal, particularly for tension or hold-down requirement.

The invention to be described herein overcomes the disadvantages inherent in ordinary pile driving techniques and achieves deep penetrations of piles into dense sand formations with a minimum of pile driving difficulty.

In accordance with the invention, pilings such as steel tubings or cylinders are driven with a hammer in a conventional way while simultaneously jetting water into the sand into which the piling is driven to reduce the resistance to pile penetration.

A primary object of the invention is to provide an improved method and apparatus for driving piles into dense sands.

The above and other objects and advantages of the invention will be apparent from the following, more detailed description of the invention when taken with the drawings in which:

FIG. 1 is a side elevation of apparatus embodying the invention and illustrating driving of the piles;

FIGS. 2 to 4 are side elevations of a pile to be driven into the underlying sand and illustrating positioning of the jet assembly and its action within the pile in accordance with the method of the invention; and

FIG. 4A is a side elevation of the upper end of FIG. 4 illustrating the driving head and anvil welded to the pile.

In the drawings FIG. 1 shows a barge **10** on which is mounted a platform **11** and a crane **12** from which is suspended a steam hammer **13** used to drive piles **14** into the dense sand formation **15**. A zone of less dense sand or mud **16** is located above formation **15** and below water **17** on which water barge **10** floats. One pile has been driven through to refusal and the other pile consisting of an initial pile section **14***a* and an upper, new pile section **14***b* is being driven into sand formation **15** by means of a driving head **18** on which is mounted steam hammer **13**. The sections of pile are welded together and to driving head **18** as indicated at **19**.

FIGS. 2 to 4 show pile section **14***a* in position for penetration into sand formation **15**. In FIG. 3 a jet-line assembly **20** is shown arranged in pile section **14***a*. Assembly **20** includes a hollow, tubular jet-line member **21** provided with an opening **22** at its upper end and perforations **23** adjacent its lower end. Centralizers **24** are arranged along its length to maintain tube **21** upright and centrally positioned within pile section **14***a*. Cable loops **25** are provided adjacent the upper end of tube **21** to aid in placing it within and removing it from pile **14**. One end of a hose **22***a* is attached to opening **22** and is used to feed water to tube **21**. The other end connects to a surface water source which supplies water to tubing **21** from which the water jets through perforations **23** and aids in washing assembly **20** through mud **16** to the tip of pile **14** (see FIG. 3). Hose **22***a* is then removed from opening **22** as shown in FIG. 4, which figure also

shows the lower end of new pile section **14***b* welded to the top of pile section **14***a* and assembly **20** extending through zone **16**. Jet-line member **21** penetrates formation **15** as water within piling **14** passes into opening **22** through jet-line member **21** and jets from perforations **23**.

FIG. 4A shows driving head **18** including the anvil portion **18***a* thereof welded to the section of pile **14***b*. Water fill-up lines **30** and an air line **31** are connected to driving head **18** to supply water or air to the driving head **18** and piles **14**. The upper end of head **18** is closed by means of plate **32** positioned below the anvil portion **18***a*.

In operation, referring particularly to FIGS. 1 and 2, the initial section of pile **14***a* is welded to driving head **18**, and then pile section **14***a* is driven down to the hard, dense sand formation **15** by means of steam hammer **13**. When pile **14***a* reaches refusal in sands **15**, the pile driving hammer **13** is removed from anvil **18***a*, the weld connection between head **18** and pile section **14***a* is severed and jet-line assembly **20** with hose **22***a* connected to it is inserted in the top of pile section **14***a* and washed down to the tip of the pile by pumping water through hose **22***a*. Hose **22***a* is afterwards removed from its attachment to opening **22**. Jet-line member **21** is positioned open-ended inside pile section **14***a* in this manner (see FIG. 4). Then driving head **18** (and anvil portion **18***a* thereof) is welded to the upper end of a new pile section **14***b*. Crane **12** then picks up and carries the welded driving head and pile section to the top of pile section **14***a* where pile section **14***b* is welded to it. Then, fill-up lines **30** are connected to driving head **18** and water is pumped into the driving head to fill the pile sections with water to a desired level. An air space **33** is left in driving head **18** and also, if needed, in a portion of pile section **14***b* as shown. As water fills the pile sections above jet-line member **21**, it will flow into jet-line member opening **22**, down through jet-line member **21**, and into formation **15** at the tip of the pile (see FIG. 4). A large, hydrostatic pressure is exerted on the underlying sand formation **15** by means of this closed hydrostatic system.

As formation **15** at the tip of pile section **14***a* begins to take water, driving with steam hammer **13** through driving head **18** of the piling is commenced. Resistance to driving of the pile is reduced by the jetting action of the water through the jet-line member **21** which permits additional penetration of the pile. The column of air **33** remains trapped so that the energy of driving is expended to the walls of the pile and not against the water column inside the pile. Air supply connection **31** is used to replenish the air supply in the event air should be lost or dissipated through the water.

Additional sections of pile are added to achieve the desired pile penetration. To add sections of pile, the driving head is removed by cutting off its connection to the last section of pile added. Then, the upper end of the new pile section to be added to the pile is welded to the driving head after which the lower end of the new pile section is welded to the last section of pile added.

Having fully described the nature, method, objects, and advantages of my invention, I claim:

1. A method for driving hollow, tubular pile sections into the ground in a substantially vertical direction in which a driving member adapted to be attached to a hammer is attachable to the upper end of each pile section to be driven and in which said driving member includes a hollow section closed at its upper end and provided with means for supplying water and air to the interior thereof, comprising the steps of:

arranging in a longitudinally extending position in a previously driven pile section a tubular means provided with openings at its upper and lower ends

adapted to jet water contained in said piles from said lower openings;

attaching a new pile section to said driven pile section;

attaching said driving member to said new pile section, the interior of said hollow section being in fluid communication with the interior of said new pile section;

adding water to said pile sections until the level of said column of water is above the level of the upper opening in said tubular means;

maintaining an air column at least in a portion of the hollow section of said driving member above said water column; and

then hammering said driving member and said attached pile sections into the ground while simultaneously jetting water under hydraulic pressure into the ground through said tubular means.

2. A method as recited in claim 1 in which additional sections of piling are added when necessary by disconnecting said driving member, attaching a new pile section to said driving member, and then attaching said new pile section to the pile section to which said driving member had been attached.

3. A method as recited in claim 2 in which said water column is maintained above the level of said tubular means and air is supplied to the interior of said hollow section of said driving member, when necessary, to maintain said air column.

4. A method as recited in claim 3 in which said pile sections are driven into sand formations underlying water in which a more dense formation material underlies a zone of less dense material including the steps of:

driving piling to refusal through said zone of less dense material prior to the step of positioning said tubular means in said piling;

removing said driving member; and

then after positioning said tubular means in said pile section, circulating water through the opening in the upper end of said tubular means and out the lower ends thereof to wash said tubular means down said piling to the lower tip thereof through the less dense material with the upper open end of said tubular means remaining above the uppermost level of said less dense material.

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