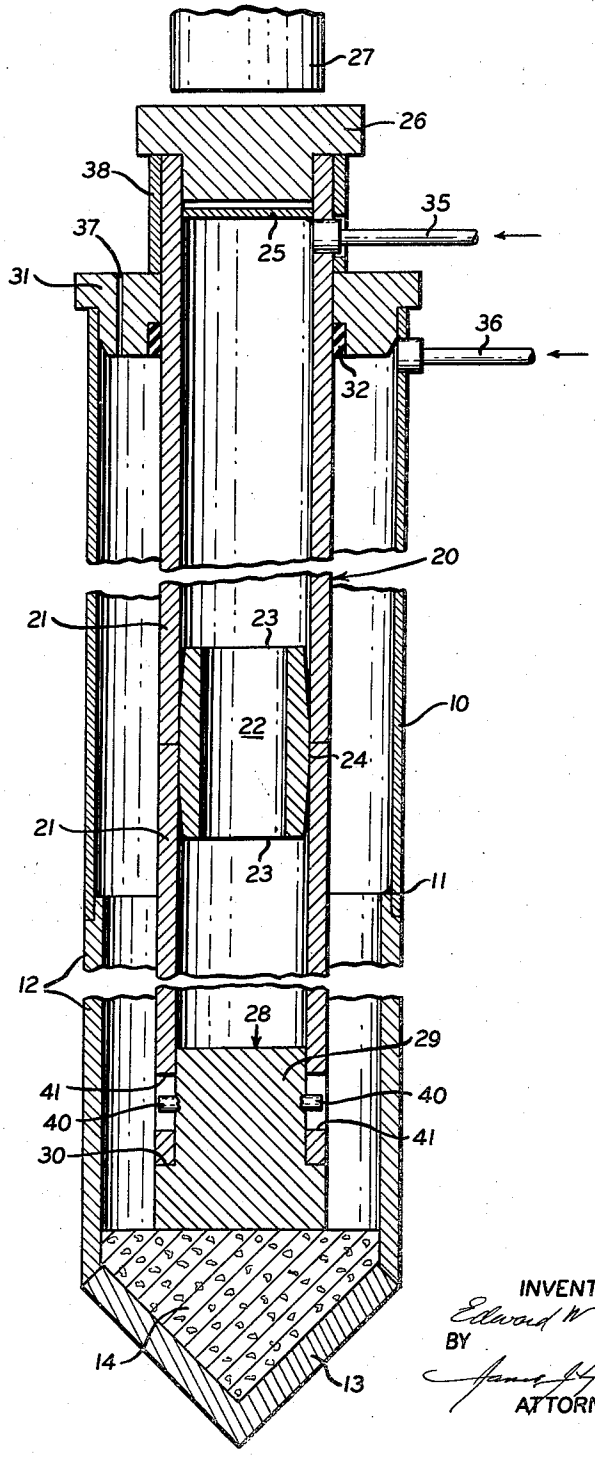
Feb. 28, 1961 E. W. FOLEY, JR 2,972,871

APPARATUS FOR DRIVING A PILE SHELL

Filed Jan. 3, 1957



INVENTOR
Edward W. Foley, Jr.
BY
James A. Hanley
ATTORNEY

United States Patent Office 2,972,871 Patented Feb. 28, 1961

2,972,871

APPARATUS FOR DRIVING A PILE SHELL

Edward W. Foley, Jr., Providence, R.I.
(P.O. Box 499, New City, Rockland County, N.Y.)

Filed Jan. 3, 1957, Ser. No. 632,359

4 Claims. (Cl. 61—53.7)

This invention relates to the driving of concrete piles.

More particularly, the invention is concerned with improvements in the method of driving or placing concrete piles, in which a pipe or casing is placed in position in the earth and the concrete is then poured into the pipe. Where sufficiently heavy walled pipe is used, the pipe may be driven without need of special reinforcement and the driving presents no special problems. However, pipe of sufficiently heavy wall thickness is expensive in any event and frequently is not available. With thin walled pipe, one known method which has been employed is the so-called Raymond Step Taper method, involving the use of a pipe tapered from butt to full diameter and having a screw joint every eight or ten feet between sections, the pipe being driven by hitting the shoulder of the connection piece which engages a screw joint. In another method, known as the Cobi method, and which is perhaps the most widely used, a mandrel made up of various leaves, the center of which is a flexible tube, is used. The tube is expanded by air pressure so that this structure bears against the side of a shaft. This stiffens the structure sufficiently to permit driving and upon release of the pressure, the center mandrel structure collapses sufficiently to permit withdrawal. In either of these methods, the mechanical complication and expense involved are considerable.

It is an object of the present invention to provide a method of driving concrete piles which may be practiced simply and economically with readily available materials and which avoids the complications inherent in the use of the mandrel structures heretofore found necessary.

Another object of the invention is to provide an apparatus and method for utilizing a water column as a force transmitting device in the driving of concrete pile casings.

A still further object of the invention is to provide an apparatus for the driving of pile casings by means of a removable core, in which improved means for overcoming the inertia of the casing is provided.

A pile driving apparatus and method embodying the invention in a preferred form will now be fully described with reference to the accompanying drawing, and the features forming the invention will then be pointed out more particularly in the appended claims.

The drawing is a vertical, axial section of the pile casing and driving core.

Referring to the drawing, there is indicated at **10** a casing or outer pipe which is to be driven, attached as by welding at point **11** comprising a generally cylindrical or tubular section **12** and point **13** which is filled as indicated at **14** with reinforced concrete up to a suitable level. A core or mandrel **20** is used and may be made up of any desired number of sections **21** of convenient length for handling. The sections **21** may be connected by bushing pieces **22**, tapered at their ends **23** for easy insertion into the core sections and having a central cylindrical section **24** machined to fit the inner diameter of the core sections **21** with a drive fit which may readily

be made water tight. The top of the core **20** is sealed off by a plate **25** welded in place and is fitted with a hammer anvil **26** against which the hammer **27** strikes. The lower end of the core is closed off by a plug **28** having a section **29** with a driven and water tight fit within the tube and a shoulder **30** against which the tube end seats. This plug rests upon the upper surface of the reinforced concrete **14** within the driving point. A water seal between core **20** and casing **10** is provided and takes the form of a collar **31**, which, preferably, has a water tight machined drive fit to the outer casing **10** and is adjustable along the core **20**. At the lower end of this collar and between it and the core **20** is a gasket **32** of rubber or other suitable material, which being forced upwardly by pressure within the space below it forms a seal under operating conditions. Water connections **35** and **36** are provided to the interior of the core **20** and to the space between the core **20** and casing or pipe **10**. In operation, the structure as just described is set up in the manner indicated in Fig. 1 and water is introduced to fill the entire inner space within the core **20** and between it and the casing **10**, being maintained under suitable pressure as by connecting a pump or pumps to the inlets. Free air is preferably vented completely so as to insure a solid column of water within the tubing.

When the hammer blow strikes the top of the stem or core through the anvil **26**, a very slight axial compression of the core **20** will produce a very great increase in compression of the water, transmitting the force of the blow largely through the water column to the plug **28** and thus to the point, driving the same into the ground, so that the casing **10** is moved principally by tension applied at its lower end and without tendency to buckle. The forces upon the core **20** comprise at any given level, a substantially radial and uniformly distributed hydraulic pressure due to the water within the tubing, and a substantially radial and uniformly distributed pressure due to water outside the tubing, plus the compressing force exerted in an axial direction due to the impact of the hammer against the upper end of the tube **20**. Since a very slight expansion of the tubing **20** under the internal hydraulic pressure will further compress the water surrounding it in the annular space between it and the casing **10**, the rupturing force due to impact is largely counterbalanced. Since the effects involved are dynamic, there will be but little effect due to travel of the water in the annular space between pipes and, hence, but little disturbance of this counterbalancing effect due to leakage at the ends of the pipe.

It will be noted that no spacers or other elements are provided intermediate the ends of the piping **20** for maintaining it centered within the outer pipe or casing **10**, and ordinarily no such means is needed.

The pipe may be driven in one piece, as indicated, as may be driven by sections, where desired, as by adding another length to the outer pipe **10** and inner pipe **20** from time to time as the driving proceeds, this being accomplished without the need for special equipment and involving merely the removal of the top core section and collar and replacement of these elements.

When the driving of the casing **10** has been completed, the pipe **20** is withdrawn, removing also the collar **31** if desired, and the casing **10** may be left full of water for support against ground pressure or may also be capped and have the water within it kept under pressure for additional support. The concrete may be poured at any convenient time and preferably by employing the "Tremie" method, introducing the concrete in the bottom of the tube and gradually replacing the water column by concrete. Alternatively, where desired, the water may be pumped out preliminary to pouring the concrete.

Plug **28** is preferably coupled to the lower end of pipe

20 as by means of pins 40 passing through slots 41 to the pipe 20 to allow a limited amount of movement. If, due to shock waves or other causes, the water pressure within the tube should rise to too high a value, this permits the plug to move slightly to relieve this condition. As pointed out above, the plug 28 has a driven fit within the core 20 which may be sufficiently tight as to sustain the weight of the plug and water column above it, normally retaining it in the position shown. An impact at the top of the casing will be communicated rapidly through the water, filling the core tube 20 and followed more slowly by an impact communicated through the core tube wall 20, due to the inertia of the latter. In consequence, the plug may unseat and move relative to the tube 20 and then be reseated as the tube 20 moves downward, the extent of this movement depending upon the impact and the material in which the pile is being driven. In any event, the movement of the plug will suffice to relieve any excess pressure which might otherwise tend to burst the tube 20.

The pipe 36 used for filling the space between casing 10 and core 20 may be eliminated, and the space around the core 20 may be filled by flow down the core and up the space around it. A slight taper on the plug 28 will permit sufficient leakage as the plug moves relative to the core to achieve this result. An air bleed passage 37 may be used in this event for venting air from the space between casing 10 and core 20, and will ordinarily be provided in any event. In accordance with well understood principles, a passage 37 of small bore will serve to bleed off air while not permitting leakage of water to any objectionable extent. A boot or sleeve 38 is also preferably provided, and extends from the overhanging shoulder part of the anvil top 26 to the cap 31, so as to transmit driving force to this element and from it to the casing 10. In the absence of this element and in particular where the pile being driven is very long, the inertia of the casing may cause difficulty, as by tearing the point off the casing. With the use of the sleeve 38, this difficulty is eliminated and sufficient force is communicated to the casing through the cap 31 to cause it to follow the point without difficulty.

The apparatus and method of the invention are not limited to piles of any special size or construction, nor are the operating conditions in general critical. While a special driving point 13, 14 has been shown, it will be apparent to those skilled in the art, that the invention is also applicable with casings equipped with so-called flat plate points. Piles have been driven without difficulty utilizing a casing 10 of about 12 gauge metal and a foot in diameter, by means of a core 20 of about 10 inches diameter and wall thickness of an inch, although greater wall thicknesses could be used to some advantage where the tubing is available. The static hydraulic pressure maintained within the core and casing is not critical and may generally be about 90 pounds per square inch. In general, it is desirable to maintain this pressure particularly through the commencement of the driving of the pile at fairly low value, increasing the pressure somewhat as the pile is driving so as to provide support for the casing 10 against ground pressure, as needed.

What is claimed is:

1. Apparatus for driving a pile comprising a tubular casing, a tubular core within the same and in spaced relation to the inner wall thereof, a driving point affixed to the casing, a lower end fitting for the tubular core closing off the same and supported on the driving point, the said fitting comprising a plug fitting in the core, a collar at the upper end of the casing closing the space between casing and core and slidably fitting the core, means on said casing and core which are adapted to communicate with a source of water under pressure for maintaining the space within the core and the space between the core and casing full of water under pressure, and an anvil fitting at the top of the core for driving the same.

2. Apparatus according to claim 1, in which the plug has a driving fit in the core and further comprising a pin and slot connection between plug and core limiting movement of the plug.

3. Apparatus for driving a pile comprising a tubular casing, a tubular core within the same and in spaced relation to the inner wall thereof, a driving point affixed to the casing with the lower end of the tubular core supported on the driving point, a collar fitting within the space between core and casing at the top of the casing and having a shoulder resting on the casing, an anvil top fitting within the core at the top thereof and having a shoulder resting thereon and extending outwardly beyond the core, a sleeve surrounding the core and extending from the said anvil top to the said collar, whereby driving impact against the said anvil is transmitted to the driving point through the core, and driving force is also transmitted to the collar and casing to overcome inertia thereof, the said core comprising a tubular member and a plug fitting in the lower end thereof and supported on the said driving point, and means on said casing and core which are adapted to communicate with a source of water under pressure for maintaining the space within the core and the space between the core and casing full of water under pressure.

4. Apparatus according to claim 3, in which the said plug has a driving fit in the core and is slidable therein, the tubular member having longitudinal slots in the said lower end and comprising also means on the plug which slidably fit in the said longitudinal slots for limiting the movement of the said plug with relation to the core.

References Cited in the file of this patent

UNITED STATES PATENTS

790,910	McClintock	May 30, 1905
869,336	Stewart	Oct. 29, 1907
886,193	De Witt	Apr. 28, 1908
1,192,247	Upson	July 25, 1916
1,622,896	Lowenstein	Mar. 29, 1927
2,312,789	Appleby	Mar. 2, 1943
2,334,386	Cortella	Nov. 16, 1943
2,738,039	Hamilton	Mar. 13, 1956