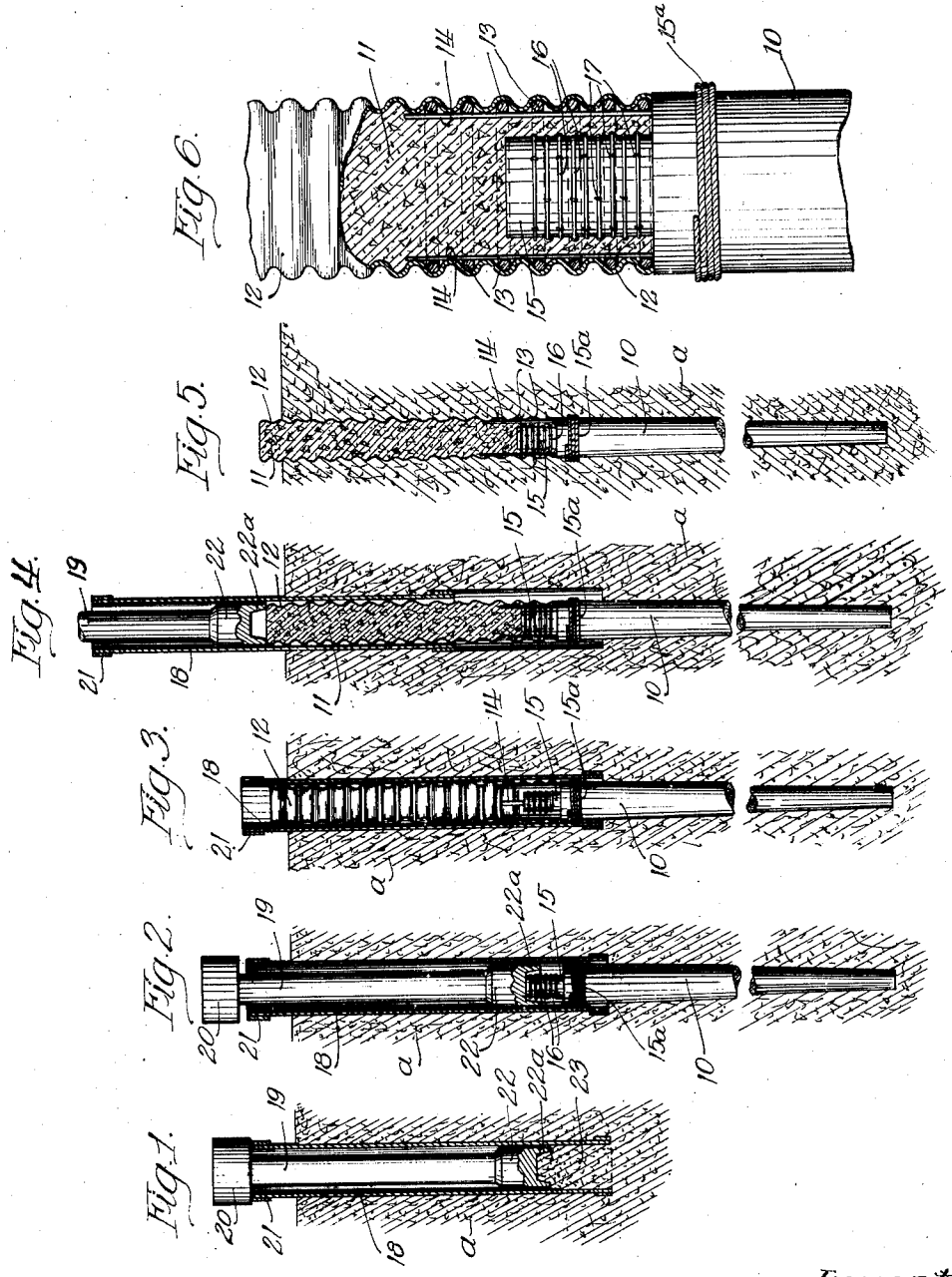
April 10, 1934. J. H. THORNLEY 1,954,188

PILE AND METHOD OF CONSTRUCTING THE SAME

Filed Aug. 18, 1930 3 Sheets-Sheet 1



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PILE AND METHOD OF CONSTRUCTING THE SAME

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Fig. 11.

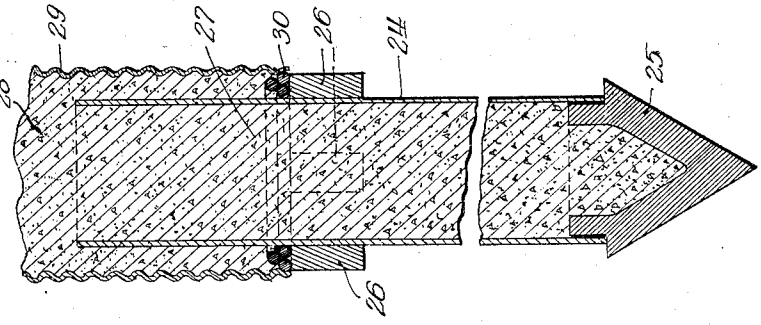


Fig. 10.

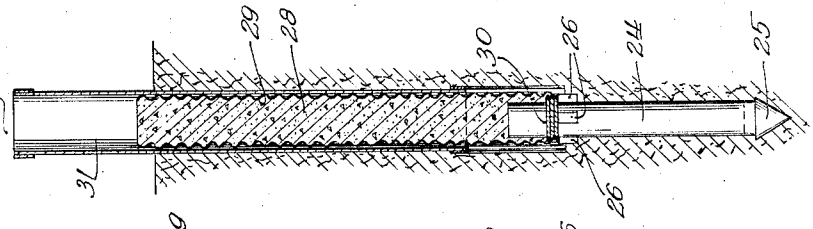


Fig. 9.

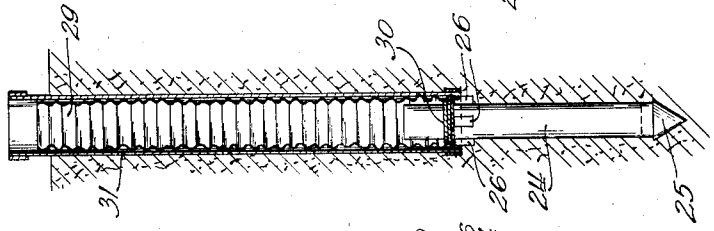


Fig. 8.

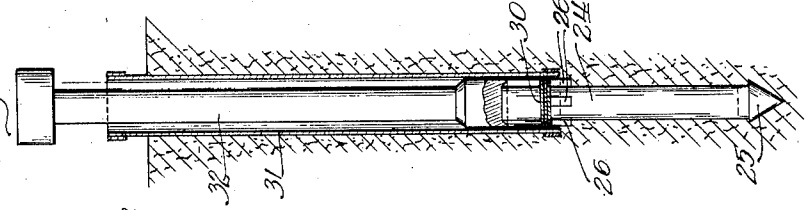
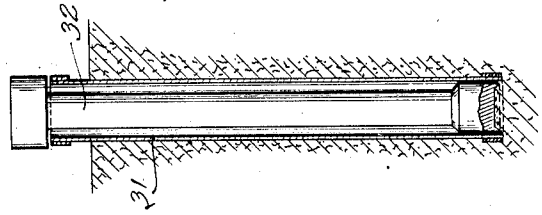


Fig. 7.



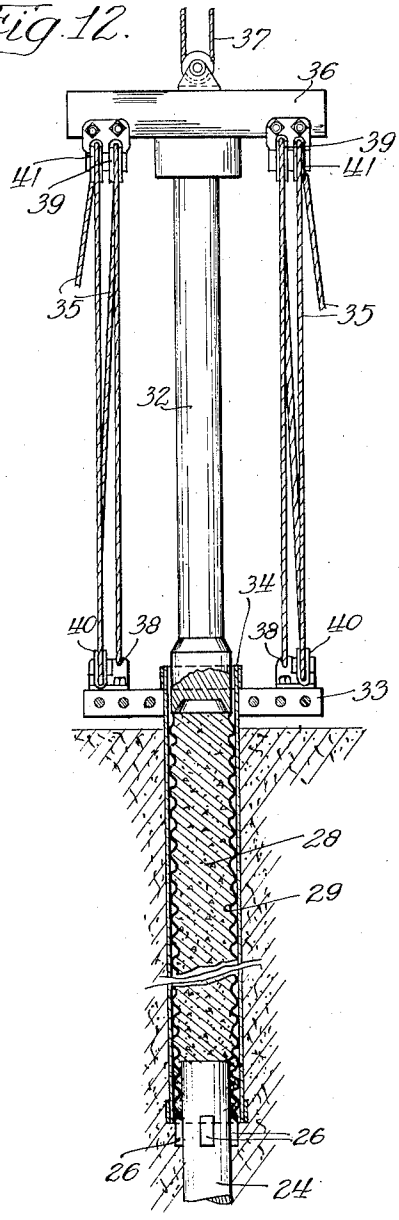
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Fig. 12.



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UNITED STATES PATENT OFFICE

1,954,188

PILE AND METHOD OF CONSTRUCTING THE SAME

Joseph H. Thornley, Evanston, Ill., assignor to Western Foundation Company, Chicago, Ill., a corporation of Illinois

Application August 18, 1930, Serial No. 475,967

5 Claims. (Cl. 61—57)

This case is a continuation in part of my copending application, Serial No. 30,429, filed May 15, 1925, entitled Piles and method of constructing same.

My invention relates to piles, and particularly to piles of the composite type in which the lower portion of the pile is formed in part or wholly of wood or metal so that it may be driven into the ground, this section being consequently referred to hereinafter as the driven section of the pile, while the upper portion consists wholly or principally of concrete which has to be cast in a previously prepared hole or shaft, this portion of the pile being, therefore, referred to as the cast in place or concrete section. Piles of this type are of particular utility where conditions are such that the lower section of the pile can be driven to a point below water level or into an earth stratum which is permanently moist while the upper section will extend into the air or through an earth stratum that may be dry at times. A wood or steel pile will remain intact so long as it is submerged in water or in a permanently wet soil. In the air or in soil intermittently wet or dry it will rot or corrode, whereas a concrete pile will remain substantially unaffected by these conditions. A pile which can be in part driven into the ground instead of being cast of concrete from bottom to top is advantageous from the point of view of economy.

One of the objects of this invention is to provide a composite pile for use in the above noted or analogous situations having certain novel and improved features of construction to be hereinafter described and claimed.

Another object is to provide a pile consisting of a lower driven section and an upper cast concrete section of such character that it may be used in situations where it is desirable to drive the pile to a hard or rocky stratum.

Further, another object is to provide a means and method for excluding water, mud and silt when sinking the pile.

Further objects of the invention are to provide certain novel methods of and apparatus for forming in situ piles of the general types indicated.

Other objects and advantages of the present invention will be apparent to those skilled in the art after a consideration of the following detailed description.

The invention is illustrated, in certain preferred embodiments, in the accompanying drawings wherein:

Figs. 1 to 5, inclusive, illustrate successive stages in the formation of a pile embodying one form of my invention, these figures being vertical sectional views;

Fig. 6 is a fragmentary view illustrating in greater detail the construction of the pile with respect particularly to the joint between the upper and lower sections thereof;

Figs. 7 to 10 inclusive are views similar to Figs. 1 to 5, inclusive, illustrating successive stages in the formation of a modified type of pile within the scope of my invention;

Fig. 11 is a fragmentary sectional view illustrating in greater detail the construction of this form of pile, and

Fig. 12 is a view, partly in section and partly in elevation, illustrating the means employed for removing from the ground the casing used in the construction of the pile

Referring first to Figures 1 to 6, inclusive, the pile consists (having particular reference to Figs. 5 and 6) of a lower driven section 10, which is shown as made of wood, an upper cast concrete section 11, a metallic shell 12, and a metal reinforcement 13, 14. The external diameter of the shell 12 is only slightly smaller than the internal diameter of the casing 18, later to be described, so that these parts have a sliding fit with respect to one another. While I have shown the shell 12 as corrugated it is to be understood that it need not be as far as the principles of the present invention are concerned. The upper end 15 of the wood section 10 is preferably of reduced diameter and extends into the concrete section 11. Preferably it is reinforced by a series of wire bands 16 (or a continuous wire might be used) fastened to the wood by staples 17. The shell 12 is preferably of the same diameter as the main body of the wood section at its upper end and the metal reinforcement consisting of circular wires or rods 14 is embedded in the lower part of the concrete section so as to surround the embedded portion 15 of the wood section. This reinforcement gives the necessary strength to the joint between the concrete section and the wood section. The metal shell 12 may also be a factor in strengthening this joint although the shell may be made of such light stock as to be negligible as a strength giving element. The primary purpose of the shell is to provide a form for the concrete when poured and while it is setting. The thickness of the shell, and hence the degree of its structural importance may be varied as the necessities of the case require.

Surrounding the upper end of the wood section 10 I secure a grommet or ring of flexible resilient

material 15a. Preferably the grommet 15a is placed a short distance below the upper end or head 15 of the pile section 10 and may take the form of a rope, if desired.

The pile so constructed is preferably formed as follows: A casing 18 is driven into the ground, together with a core 19 having a head 20 bearing against the reinforced upper edge 21 of the casing. This operation may be performed by any suitable pile driving apparatus. Preferably the lower enlarged end 22 of the core is provided with a bell or cupped end 22a and is so arranged that the core does not extend quite to the lower edge of the casing so that a plug of earth 23 (Fig. 1) is left in the casing when the core is withdrawn, which is the next operation.

The wood section 10 is then driven into the ground through casing 18 (Fig. 2), this operation being accomplished by means of the core 19, the lower end of which, being cupped at 22a, receives and centers, and prevents the bruising of, the end of the pile. During this operation the grommet 15a acts as a packing to prevent any mud, silt and the like from flowing around and above the upper end or head 15 of the wood section 10. In addition, being spaced below the upper end the grommet or packing 15a cooperates with the cupped end 22a to center the section in the casing 18. As the wood section penetrates the plug of earth 23 in the lower end of the casing this earth is crowded out against the casing so as to form a seal tending to prevent ingress of water to the casing. Thus all water and mud is positively prevented from entering the casing 18, either when the core 19 is withdrawn, as mentioned above, or at any other time. Furthermore, the grommetted wood pile section 10 acts as a plunger in a pump, forcing out of the casing any water or mud which may have entered during the withdrawal of the core or otherwise.

If the pile is formed at a place where there is a permanent water bearing stratum below an earth stratum which is alternately wet and dry, the wooden section will be driven to a point below the level of permanent moisture.

After driving the wood section 10 through the plug of earth 23 in the casing 18 the next operation, as indicated above, is to withdraw the core 19 and place within the casing 18 the shell 12 (Fig. 3) and the metallic reinforcement consisting of hoops 13 and longitudinal rods 14 (Figure 6). The members or hoops 13 are preferably secured in any manner near the lower end of the shell 12 and, in cooperation with the rods 14, serve as a short reinforcing cage spaced and positioned to surround the upper end or head 15 of the wood pile 10. It is evident that if the head of the pile 10 is centered in the casing and if the reinforcing cage is centered in the shell 12 closely fitting the casing, the reinforcing of the splice between the wood section 10 and the concrete section 11 will be properly centered. By attaching the cage within the shell 12 a short reinforcing cage in the splice section only is made possible.

After the core 19 is withdrawn the shell 12 is then filled with concrete and casing 18 is withdrawn (Fig. 4). The core may be positioned so as to prevent the shell from being pulled out with the casing.

The use of the grommet serves the exceedingly essential purpose of keeping the lower end of the shell 12 dry so that the concrete at the splice is not weakened by any admixture of earthy or organic material, or water or the like. Hence a good joint between the concrete and wood sections is secured.

Figs. 7 to 11, inclusive, illustrate a modified form of composite pile, consisting of a lower driven section and an upper cast section, together with the method of forming the same. The lower portion of the pile is composed of a tubular metallic section 24 provided at the bottom with a point 25 and at a place near its upper end with lugs 26. The section 24 is provided with a grommet 30 of rope or the like just as in the case of the modification shown in Figs. 1 to 6. In this case I have shown the grommet 30 just above the lugs 26, but it is to be understood that any other location spaced from the upper end is contemplated. The grommet 30 is secured to the section 24 in any desired manner. This driven pile section is preferably filled, either before or after it has been driven, with a body of concrete 27. The upper portion of the pile consists of a body of concrete 28 of greater diameter than the tubular section 24 surrounded by a metallic shell 29 shown as consisting of a corrugated pipe. The shell 12 of the form of the invention shown in Figs. 1 to 6 might also be corrugated, this combination having the advantage of bonding the concrete with the shell.

The preferred method of forming the pile above described is as follows:

A casing 31 and core 32 are first driven into the ground (Fig. 7). The core is then removed and the tubular section 24 with its grommet 30 and point 25 is placed in the casing 31 and driven down into the ground through the agency, for example, of the core as shown in Fig. 8. The length of the pile may be calculated so that the point 25 is driven into a hard or rocky stratum. As in the previous modification, the driven section is centered in the casing, but in this modification the projections 26 and the grommet 30, either or both, afford substantially sliding contact with the casing 31. As in the previous modification the grommet 30 effectively seals the casing 31 against any inflow of silt and the like. The core 32 is again removed and the metallic shell 29 is placed in the casing. In placing and driving home the shell 29 the lower end thereof, fitting closely within the casing 31, engages and embraces the grommet 30 so that a tight seal is effected between the lower end of the shell and the section 24. The pile is then filled with concrete forming the concrete bodies above referred to and designated 27 and 28 and the casing 31 is then removed, the grommet 30 effectively preventing the entrance of water, mud, and the like during this process.

When the casing is withdrawn the core may be fixed in a position to prevent the shell from being pulled out with the casing. As shown for example in Figure 12, the casing 31 may be raised by means of a cross head 33 formed to engage the collar 34 on the upper end of the casing. Cross head 33 is supported by cables 35, 35 from a cross beam 36 suspended by a cable 37 from any suitable support (not shown). Cables 35 are fixed to cross head 33 at points 38, 38 extending over sheaves 39, 39 on the beam 36, then around sheaves 40, 40 on the cross head, then over sheaves 41, 41 on the beam and to the hoist. Obviously power for lifting the casing might be multiplied to any extent. When the core 32 has been placed against the body of concrete 28, or preferably against the upper edge of shell 29, beam 36 is lowered so as to bear against the head or upper end of the core and cable 37 is dead

ended to fix the position of beam 36. Cables 35, 35 are taken up by the hoist, raising cross head 33 and drawing the casing from the ground. The core 32, however, prevents the shell 29 from being pulled out with the casing which might otherwise occur for various reasons, such as too tight a fit between shell and casing or the bursting of the shell due to the weight of the concrete.

This means for raising the casing is also preferably used in the formation of the piles of Figures 1 to 6.

While I have shown the grommets 15*a* and 30, and the projections 26, as forming means for sealing the lower end of the casing and as aiding the centering of the lower pile section, it is to be understood that the lower pile sections themselves may be made with a diameter sufficient to establish with the casing a seal effective for all practical purposes to prevent the ingress of water, mud and the like, and also effective in cooperating with cup or recess 22*a* to center the lower pile section in the casing.

I have shown and described my invention as embodied in certain preferred constructions and method, but contemplating possible modifications I desire to claim the invention generically in all aspects within the scope of the appended claims.

I claim:

1. The method of forming piles which comprises driving into the ground a casing and enclosed core, compressing the soil around and within the lower end of said casing, inserting a lower pile section into the casing and driving same into said compressed soil portion, guiding the lower pile section by establishing sliding contact at two vertically spaced points, casting an upper pile section in the casing and bonding same to the upper end of the lower pile section, and withdrawing said casing.

2. The method of forming piles, consisting in providing a smooth surfaced cylindrical casing and forcing the same into the ground, driving a lower pile section down through said casing and simultaneously establishing a liquid tight seal between the section and casing whereby the former acts as a piston to drive out any water and silt in the casing, and then placing and bonding an upper pile section to the lower section.

3. A method of forming a pile which comprises driving a casing the lower end of which is open and a separable core into the ground, the penetration of the core being less than that of the casing, whereby a plug of earth is compressed in the lower portion of the casing; removing the core and driving a pile section into the ground through the casing and the plug of earth therein; placing a shell in said casing; filling the shell above said pile section with concrete; and withdrawing the casing.

4. A pile comprising a lower driven section, an upper cast in place concrete section in which the upper end of the driven section is embedded, and with which it is united, a metal shell surrounding and united with the concrete section, and a metal reinforcing structure secured to the shell and embedded in the concrete between the upper end of the driven element and the shell.

5. A pile comprising a lower driven section, an upper cast in place concrete section in which the upper end of the driven section is embedded, and with which it is united, a metal shell surrounding and united with the concrete section, reinforcing means secured to the upper end of the driven section, and a metal reinforcing structure embedded in the concrete between the upper end of the driven section and the shell and spaced outwardly from said reinforcing means.

JOSEPH H. THORNLEY.