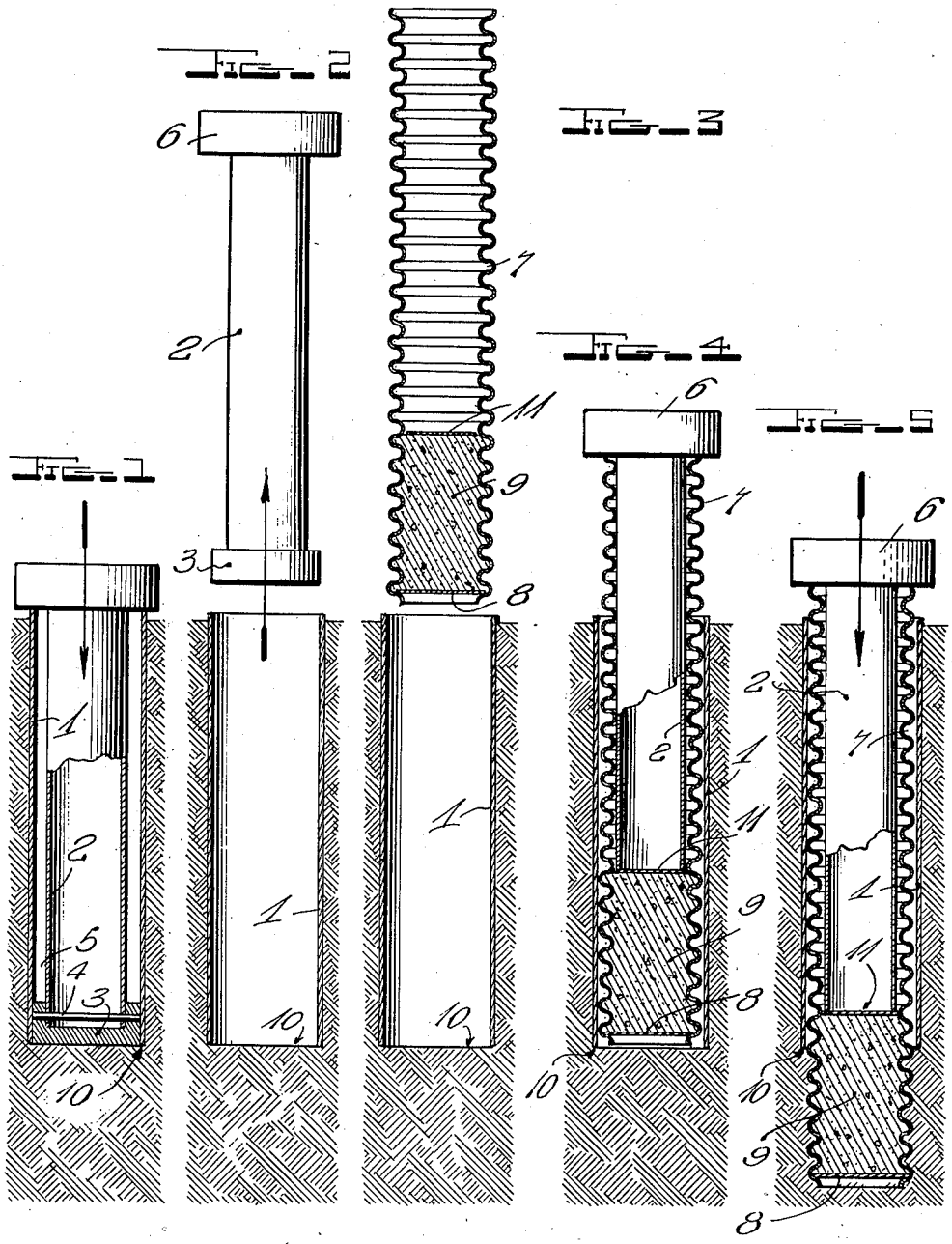
Aug. 10, 1943. J. F. McCOOK 2,326,155

METHOD OF CONSTRUCTING PILES

Filed Oct. 3, 1939 2 Sheets-Sheet 1



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FIG. 6

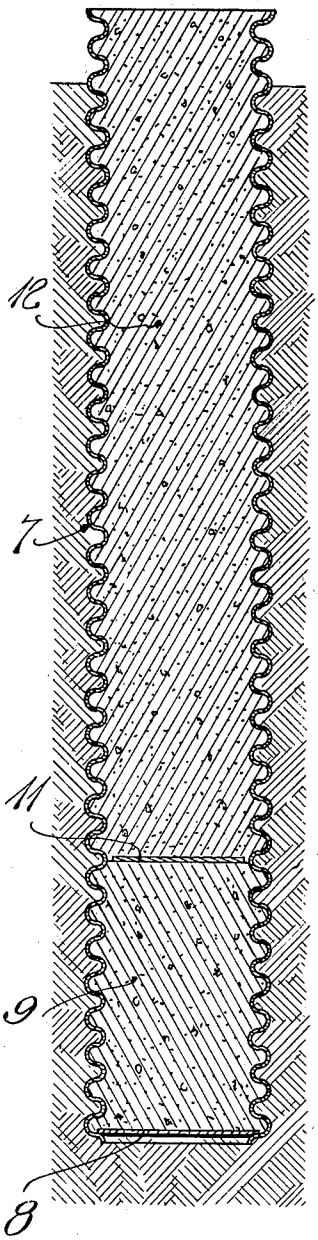


FIG. 7

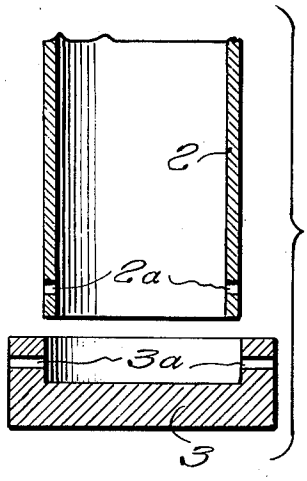


FIG. 8

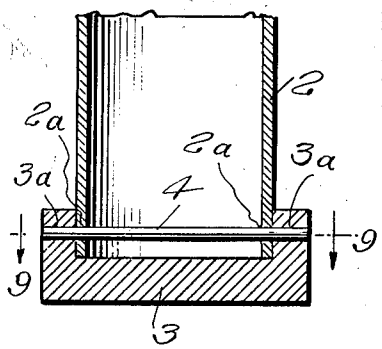


FIG. 9

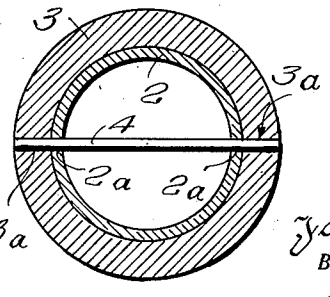


FIG. 10

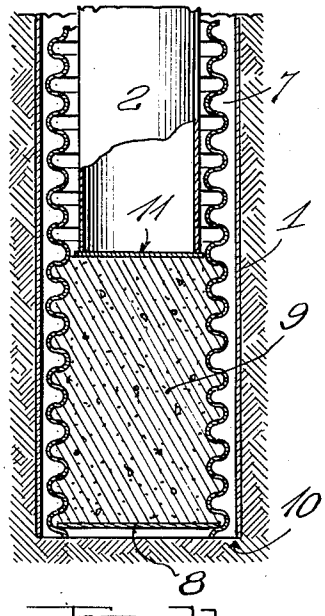
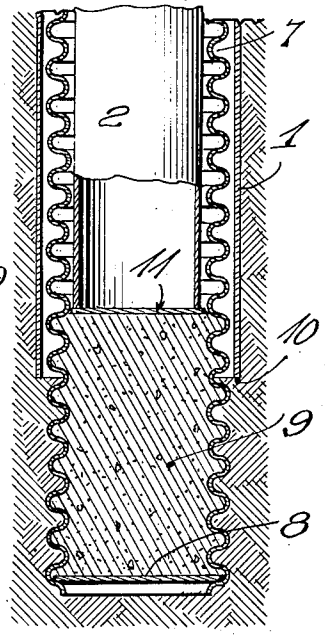


FIG. 11



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Patented Aug. 10, 1943 2,326,155

UNITED STATES PATENT OFFICE

2,326,155

METHOD OF CONSTRUCTING PILES

Joseph F. McCook, Scarsdale, N. Y.

Application October 3, 1939, Serial No. 297,740

1 Claim. (Cl. 61—57)

My invention relates broadly to improvements in the method of forming piles and like structures and in the improved construction of a pile.

One of the objects of my invention is to provide an improved method of forming piles and like structures inexpensively and expeditiously in a manner in which the piles will remain permanently erected for an indefinite time.

Another object of my invention is to provide a method of forming piles in which relatively inexpensive materials may be employed and a structure obtained which is permanent in character and having substantial shear strength and bearing capacity.

Still another object of my invention is to provide an improved method for directly casting in place, piles having large bearing capacity which consists in lining a bore through which a metallic loaded shell may be introduced and driven to a desired supporting depth, the shell thereafter filled with concrete and the lining removed and the pile arranged to support the load.

A further object of my invention is to provide a construction of reenforced concrete pile in which a metallic liner is employed for lining the bore into which the pile is to be cast in place and a reenforced metallic shell introduced through the liner wherein the shell has an effective length greater than the length of the liner and extending therefrom proportional to the distance the shell is to be driven, the shell being provided with a precast concrete header adapted to penetrate beyond the length of the liner, the liner being subsequently removable after the reenforced shell has been wholly filled with concrete.

A still further object of my invention is to provide a construction of inexpensive pile which may be cast in place by first sinking a protective casing, utilizing a suitable core-like ram, removing the core-like ram and sinking into the protective casing a reenforced shell having a concrete header therein wherein the reenforced shell is substantially longer than the protective casing by a length proportional to the distance the pile is to be driven and the load to be supported, utilizing the core-like ram for driving the reenforced shell by forces applied axially against the concrete header for driving the concrete header beyond the terminating end of the protective casing, removing the core-like ram, filling the interior of the reenforced shell with concrete, and thereafter removing the protective casing.

Other and further objects of my invention reside in the method of forming cast in place encased friction piles and an improved construction thereof as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 is a vertical sectional view showing the protective casing and associated reenforcing central core and removable header thereon driven to a position below the ground line; Fig. 2 illustrates the arrangement of the protective casing in the ground while the central core has been withdrawn therefrom; Fig. 3 is a longitudinal sectional view of a corrugated pile prepared with a filler of concrete in the nose thereof preparatory to being lowered into the protective casing shown in cross section in the drawings; the length of the shell being greater than the length of the protective casing; Fig. 4 illustrates the next step in the formation of the pile in which the reenforced metallic shell of corrugated section having the concrete header therein and projecting beyond the length of the protective casing by a distance proportional to the distance to which the pile is to be driven and proportional to the loading above the ground line is shown, the core-like ram being shown in position preparatory to driving the concrete header beyond the length of the protective casing; Fig. 5 illustrates the position of the corrugated shell and concrete header therein after being driven by the core-like ram for a distance beyond the end of the protective casing with the shell projecting above the ground line for supporting the load; Fig. 6 shows the corrugated shell completely filled with concrete and the protective casing removed and the pile in normal position for supporting a load; Fig. 7 is an enlarged fragmentary longitudinal sectional view showing the end of the core-like ram and the removable header thereon illustrated in disassembled position; Fig. 8 is a cross sectional view similar to Fig. 7 showing the removable header in position on the end of the core-like ram; Fig. 9 is a transverse sectional view on line 9—9 of Fig. 8; Fig. 10 is an enlarged fragmentary sectional view of the corrugated shell having a filler of concrete in the nose thereof about to be driven into the ground beyond the protective casing; and Fig. 11 is an enlarged sectional view similar to the view shown in Fig. 10 showing how the corrugated shell is driven into the ground while protecting the corrugated shell against stress and strain due to friction of the earth against the corrugated shell.

The method of forming piles and the construction of pile according to my invention has been developed to overcome disadvantages heretofore existing in the art of pile driving and pile struc-

tures. Heretofore in the formation of cast in place piles it has been proposed to sink pipe-like structures and fill such structures with concerete. This construction has proven highly expensive. My invention provides a structure in which the protective casing is used only during the period of construction of the pile and is thereafter removed and does not remain a permanent part of the pile structure. The reenforced shell which retains the concrete in the pile of my invention may be of relatively thin gauge metal which is relatively inexpensive and yet adequate to provide the mechanical reenforcement required to withstand the loads involved. The bearing capacity of the pile of my invention is based upon the skin friction developed between the earth and the external surface of the pile; and the method of constructing this pile differs from all other methods of constructing encased concrete piles in that, in this case, the skin friction and built-up resistance is developed upon the finished pile itself and not merely upon the protective steel casing.

A further advantage is that friction is eliminated from the exterior wall of the shell and the load of the pile may at all times be easily and exactly computed from known mathematical formula, thus the necessity and expense of making load tests is eliminated thus contributing to efficiency and further eliminating costs. After the protective casing and its assembled core-like ram have been driven to the desired depth the core-like ram is removed, leaving the protective casing in position and a reenforced metallic shell, preferably of corrugated construction, introduced through the interior of the protective metallic shell with a concrete header in the lower end thereof, the length of the shell projecting beyond the upper end of the protective casing for a distance proportional to the distance to which the pile is to be driven and the distance above the ground line at which the load is to be supported. The core-like ram is employed for driving the shell beyond the end of the protective casing but only for a distance where the concrete header overlaps the lower terminus of the protective casing, thereby substantially eliminating excessive stresses and strains in the material forming the walls of the shell, in that portion of the shell which remains above the terminus of the lower limits of the protective casing. After the core-like ram has been employed for driving the shell to the depth as prescribed, the core-like ram is removed, the shell filled with concrete, and thereafter the protective outside casing removed whereupon the reenforced pile after setting is ready to receive the load.

Referring to the drawings in more detail, reference character 1 designates the outside protective casing which is assembled with the core-like ram 2 disposed centrally therein, the core-like ram 2 having an end cap 3 detachably secured thereon by means of removable pin 4. The end cap 3 is removable from the end of core-like ram 2 to enable the core-like ram 2 to be subsequently used in driving the reenforced shell and concrete header therein as will be hereinafter described. The diameter of the removable end cap 3 is such as to provide an annular spacing 5 between the interior wall of the protective casing 1 and the external diameter of the core-like ram 2 adequate for the introduction of the reenforced shell which will be hereinafter described. I have indicated at 6 the driving means which is effective against the upper end of protective casing 1 and the upper end of core-like ram 2 for driving both the protective casing 1 and core-like ram 2 to the required depth illustrated in Fig. 1.

I have shown in Fig. 2 the core-like ram 2 withdrawn, leaving the protective casing 1 in position in the ground preparatory to receiving the reenforced shell illustrated more clearly in Fig. 3.

In Fig. 3 I have shown the corrugated sheet metal shell 7 which is corrugated in section for increasing the shear strength and bearing capacity. The corrugated sheet metal shell 7 has an end plate 8 which is suitably secured in the end of the shell such as by binding friction imparted by the forcing of the end plate 8 within one of the end corrugations. The lower end of the corrugated sheet metal shell 7 is filled with concrete to provide a concrete header indicated at 9. The length of the corrugated sheet metal shell 7 is such that the shell, when initially placed in position through the protective casing 1, projects above the upper end of protective casing 1 for a distance proportional to the distance to which the shell is to be driven and for a distance proportional to the height at which the load is to be supported above the ground line. The concrete forming the concrete header 9 is poured into the corrugated sheet metal shell 7 before the shell is lowered in position interiorly of protective casing 1 and is allowed to set to enable the concrete to reach the hardness necessary to withstand the subsequent driving as shown in Fig. 3. A plate 11 is dropped into place within corrugated shell 7 on top of the concrete header 9 as shown. When the concrete forming the header 9 has set, the reenforced shell is lowered into position interiorly of protective casing 1 as shown in Fig. 4 and is driven into the ground by blows applied upon driving means 6 from a suitable pile driver and transmitted through the concrete header 9. The driving operation is continued until the corrugated sheet metal shell 7 and concrete header 9 penetrates the earth to the position shown in Fig. 5, until the desired degree of friction and bearing capacity is attained. The driving operation is discontinued before the upper limit of the concrete header 9 is allowed to pass the lower terminus 10 of the protective casing 1, thereby eliminating excessive stresses and strains on the wall structure of corrugated sheet metal shell 7 which would otherwise be brought about by friction of the reenforced casing against the earth.

The concrete header 9 serves an important function in protecting the corrugated sheet metal shell 7 for if the corrugated shell was driven without the concrete plug in the lower end, such shell in the course of the driving operation would inherently rub against rocks, etc., and be injured, thus permitting water and mud to seep into the shell. The pile of my invention has the concrete header 9 in the lower end thereof to the full extent to which it is driven below the outside casing and no amount of rubbing against obstacles can cause a breakage or a leak. Thus I provide a clean, dry, pile of great permanency.

When the pile has been driven to the position shown in Fig. 5, the core-like ram 2 is withdrawn and the hollow corrugated sheet metal shell 7 is filled with concrete from the upper limit of concrete header 9 at plate 11 to the upper end of the corrugated sheet metal shell 7 as shown at 12 in Fig. 6. The protective casing 1 is then withdrawn and the forming of other piles commensed. This method permits the driving of any desired number of piles in less time and

at less expense than by any method shown by the existing art.

In Fig. 7 I have shown a fragmentary sectional view of the lower end of the core-like ram aad the socket-like construction of the removable end cap 3 which fits over the end of the core-like ram 2. Diametrically opposite apertures 2a are provided adjacent the lower end of the core-like ram 2 as indicated at 2a and alignable diametrically extending apertures 3a are provided in the socket-like removable end cap 3. The removable end cap 3 extends beyond the diameter of the outside of the core-like ram 2 to provide for the annular spacing 5 between the core-like ram 2 and the interior wall of the protective casing 1 so that the core-like ram 2 is constantly driven downwardly while maintaining alignment within the protective casing 1. In Fig. 8 I have shown the assembled relation of the removable end cap 3 and the core-like ram 2 effected by means of removable pin 4. Fig 9 shows a transverse sectional view of the manner in which the removable pin 4 extends diametrically through the removable end cap and core-like ram for maintaining the removable end cap in position.

Figs. 10 and 11 show the two extreme positions of the concrete header of the corrugated sheet metal shell 7, that is, the position before driving the pile and the position when the driving operation is approximately complete. It will be seen that the concrete header within the corrugated sheet metal shell 7 at all times protects the corrugated sheet metal shell 7 against the frictional forces developed by the driving operation. That is to say, in the driving of the corrugated sheet metal shell 7 from the position shown in Fig. 10 to the position shown in Fig. 11, the walls of the hollow portion of the corrugated sheet metal shell 7 at no time contact the earth. The driving of the pile is discontinued in approximately the position illustrated in Fig. 11, that is, before the upper limit of the concrete header 9 passes below the lower terminus 10 of the protective casing 1 so that frictional stresses and strains on the hollow portion of the wall structure of the corrugated sheet metal shell 7 are eliminated.

It is not essential that the header 9 be precast in the shell 7 before the shell is lowered into position in the protective casing 1. In some instances it may be more feasible and convenient to manipulate the shell 7 without the added weight of the concrete header 9, and in such cases the production of the header may be postponed until the shell 7 has been lowered within the protective casing 1, whereupon the required amount of concrete may be introduced into the shell and allowed to harden to form the header 9, before the shell 7 is driven the required added distance into the earth below the lower terminus of the protective casing.

While I have described my invention in accordance with the preferred manner of carrying out the method of my invention for forming a pile according to the preferred construction of my invention, I realize that modifications in detail may be made and I do not intend my invention to be limited to the specific method or steps enumerated or to the particular methods involved, but desire that my invention cover modifications of my method and modifications of the structure produced thereby and I intend no limitations upon my invention other than may be imposed by the scope of the appended claim.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

In a system for forming piles wherein a core-like ram and casing are driven into the earth, the ram withdrawn, and a shell having a concrete header therein lowered through the casing, the method of forming the pile which consists in driving the concrete header into the earth by blows delivered by said ram against the upper end of said concrete header within said shell through the casing to a distance in which the upper surface of the concrete header extends above the lower terminus of the casing for preventing direct exposure of the annular zone of said shell immediately adjacent the upper end of said concrete header to friction and abrasion against the earth, withdrawing the core-like ram, filling the shell with concrete extending from the upper surface of said concrete header through said shell and thereafter removing said casing and retaining the concrete filled shell pile in the earth.

JOSEPH F. McCOOK.