Dec. 15, 1959 B. C. GERWICK, JR 2,916,794

PRE-STRESSED CONCRETE PILE CONSTRUCTION

Filed March 23, 1954

FIG_1_

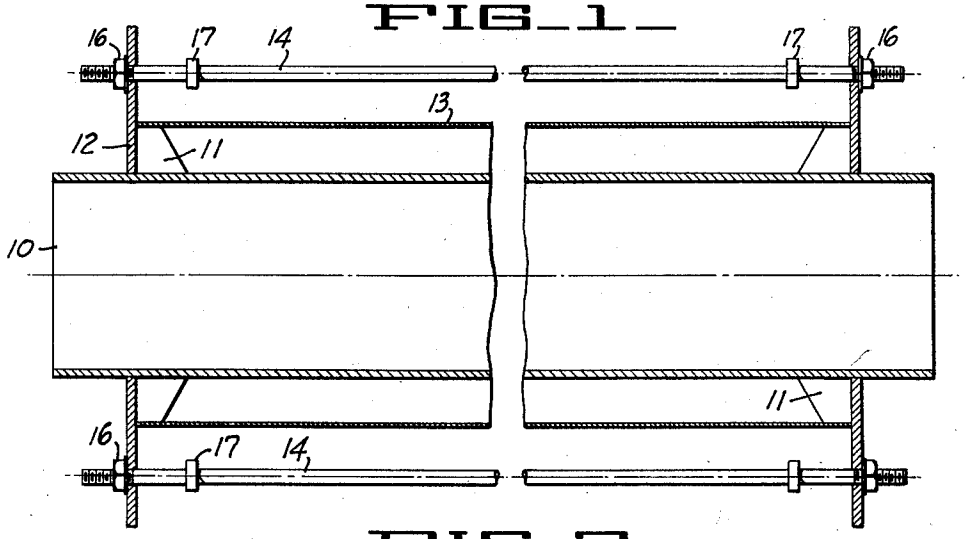


FIG_2_

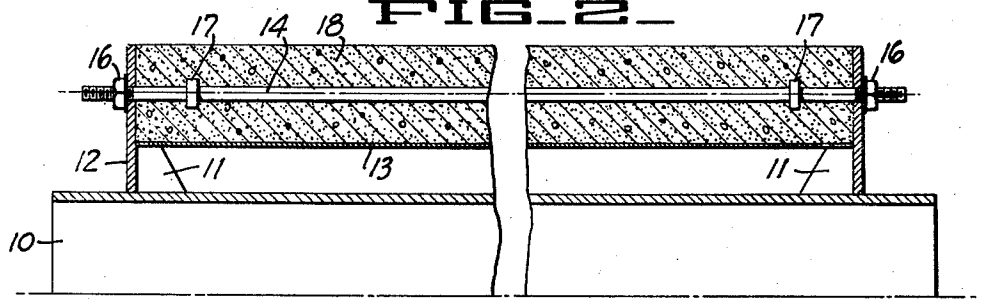
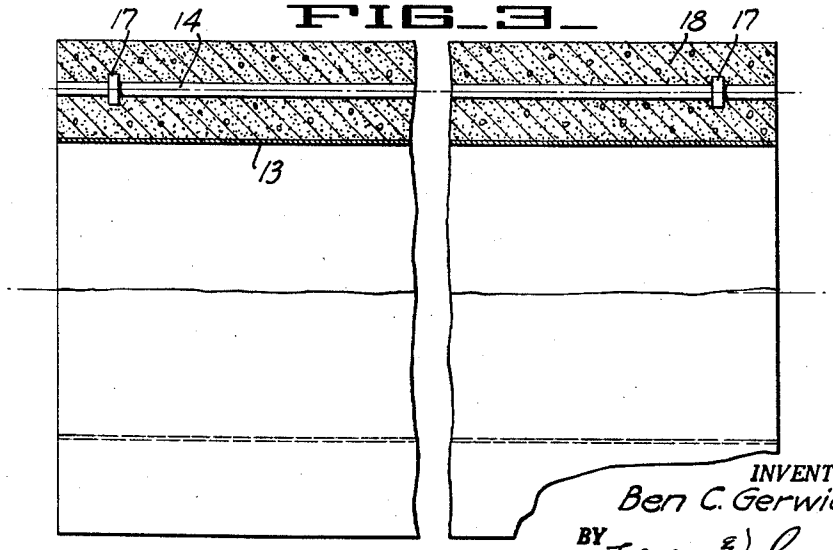


FIG_3_



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PRE-STRESSED CONCRETE PILE CONSTRUCTION

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Application March 23, 1954, Serial No. 417,986

2 Claims. (Cl. 25—118)

This invention relates generally to concrete structures of the pre-stressed type. More particularly it relates to the construction of pre-stressed concrete piles.

In the construction of reinforced concrete piles it has been found that the use of pre-stressing makes possible economies in size and weight. One common method for constructing reinforced concrete piles is to cast the pile body with one or more tubular openings extending longitudinally through the same, after which reinforcing wires, cables or steel rods are threaded through the openings, and tensioned to apply compressional stresses to the body. Grouting is then introduced into the longitudinal openings to form a bond between the reinforcing members and the body. This method has the disadvantage that it is troublesome and somewhat expensive to cast the concrete body with openings extending longitudinally of the same, for receiving the reinforcement. The use of tubes or pipes for this purpose adds materially to cost of manufacture and frequently necessitates special means for holding the pipes in proper position during casting or molding. A further disadvantage is that it is somewhat troublesome to thread reinforcing members through relatively long tubular openings, after the concrete has hardened. Unless great care is taken to form the openings quite straight the reinforcing members upon being tensioned may be displaced from a desired axial position, and may apply lateral forces or bending stresses to the body.

In general it is an object of the present invention to provide pre-stressed reinforced concrete piles which will avoid the necessity of providing longitudinally extending passages for receiving the reinforcement, and which will obviate troublesome threading of the reinforcement through the passages, as described above.

Another object of the invention is to provide concrete piles of the above character which will facilitate rapid manufacture of the pile by the use of Gunite concrete, and which is characterized by the fact that the reinforcement is stressed prior to the application of the concrete.

Additional objects and features of the invention will appear from the following description in which the preferred embodiments have been set forth in detail in conjunction with the accompanying drawing.

Figure 1 is a side elevational view in section illustrating equipment used for carrying out the present method.

Figure 2 is a detail in section illustrating the equipment of Figure 1 after concrete has been applied.

Figure 3 is a half section of a concrete pile after its manufacture.

The equipment illustrated in Figure 1, which is exemplary of the apparatus of the present invention, consists of a stud member **10**, which can be in the form of steel pipe or conduit. Lugs **11**, which are attached to the pipe adjacent its ends, form shoulders for the removable end plates **12**. Positioned between the plates **12** and about the pipe **10**, there is a cylindrical form **13**, which can be made of relative light sheet metal. If

desired this form can be made collapsible so that it can be removed from the finished pile.

The end plates **12** are provided with circumferentially spaced openings or slots adapted to receive the reinforcing members **14**. These members can consist of steel rods provided with threaded ends engaged by the nuts **16**. In place of rods, steel wires or cables can be used, together with means for engaging the ends of the same whereby a predetermined amount of tension can be applied and retained. Assuming the use of steel rods one or more thrust collars **17** can be attached as by welding, at regions near the plates **12**. Similar anchoring abutments can be attached to steel wires or cables.

After the reinforcing members have been positioned in the manner illustrated in Figure 1, a predetermined tension is applied to the same, as by turning the nuts **16**. The end plates **12** together with the central pipe **10**, are formed to adequately withstand these forces, and to thereby maintain the rods **14** under the tension desired in the final pile.

The next step in the use of the apparatus is to apply a concrete mix about the form **13**, over the reinforcement **14**. The concrete can be a coarse cement mortar applied by Guniting or some similar method. Gunite concrete is delivered pneumatically through a conduit and discharged through a nozzle with considerable velocity. Other methods can be used for applying a relatively dry mix, as for example methods in which the mix is propelled mechanically and delivered with considerable velocity where desired. As is well known to those familiar with Guniting, a substantially uniform layer can be built up upon the form **13**, while the form is in general horizontal position and is supported in such a manner that it may be rotated through 360°. Application of Gunite concrete in this manner forms the body **18** about the core **13**, of such thickness as to completely embed the reinforcement **14**.

Following the application of the Gunite concrete, the applied layer is permitted to harden, and thereafter the nuts **16** or other anchoring means is removed from the reinforcement, the plates **12** separated from the lugs **11**, and the pipe itself removed from the body **18**. As previously mentioned the form **13** may be permitted to remain as a permanent body of the pile, or it can be made collapsible and removed together with the other parts of the equipment. After cutting off any projecting ends of the reinforcement, the complete pile appears as in Figure 3. The reinforcement **14** remains in tensioned condition, but instead of the tension being carried by the plate **12** and pipe **10**, it is now carried completely by the body **18**, by virtue of the bond established between the ends of the reinforcement and the adjacent concrete. It will be evident that by proper selection of tension prior to applying the concrete, a predetermined amount of tension can be had in the finished pile.

In the procedure described above the entire layer of Gunite concrete is built up in one Guniting operation. In place of this procedure it is possible to apply a preliminary layer of Gunite, prior to applying the reinforcement **14**. Thereafter the reinforcement is applied, tensioned, and the Guniting continued to complete the body.

In the foregoing no reference is made to use of reinforcement other than the pre-tensioned members. It will be evident however that other reinforcement can be used if desired, as for example one or more layers of wire reinforcing netting.

It will be evident that the apparatus described above has a number of advantages over conventional apparatus. The reinforcing members are initially tensioned separate from the concrete body. No passages are cast in the body, and it is not necessary to thread reinforce-

ment through such passages after the concrete has hardened.

I claim:

1. Apparatus for the manufacture of a pre-stressed concrete pile, comprising: a rigid mandrel capable of withstanding forces in compression, flanges detachably fixed to the ends of the mandrel and capable of mounting reinforcing rods extending longitudinally of the mandrel whereby when said reinforced member are tensioned the mandrel carries all the resulting stress in compression, and a form uniformly and removably disposed in outwardly spaced relation about the mandrel and extending between said flanges, the exterior periphery of the form being spaced inwardly with respect to the reinforcing rods, the space surrounding the form being substantially unobstructed except for said rods and being adapted to receive a concrete mix, whereby said form is relieved of any appreciable stresses in compression during the forming and pre-stressing of such pile.

2. Apparatus for the manufacture of pre-stressed concrete pile, comprising: a rigid mandrel capable of withstanding forces in compression, flange means carried by the ends of the mandrel for receiving reinforcing members extending longitudinally of the mandrel, said means being spaced radially from the periphery of the form, means for detachably securing said reinforcing members to said end receiving means, said last mentioned means permitting longitudinal tension to be applied to said reinforcing members, and a light weight removable form disposed in uniformly spaced relation about the mandrel and extending between said flange means, the exterior periphery of the form being spaced interiorly with respect to said reinforcing rods, whereby said mandrel carries substantially all of the resulting stress compression without transfer of any appreciable stress to said form.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,916,794 December 15, 1959

Ben C. Gerwick, Jr.

It is hereby certified that error appears in the printed specigication of the above numbered patent requiring correctio and that the said Letters Patent should read as corrected belo

Column 3, line 9, for "reinforced member" read -- reinfor members --.

Signed and sealed this 14th day of June 1960.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents