

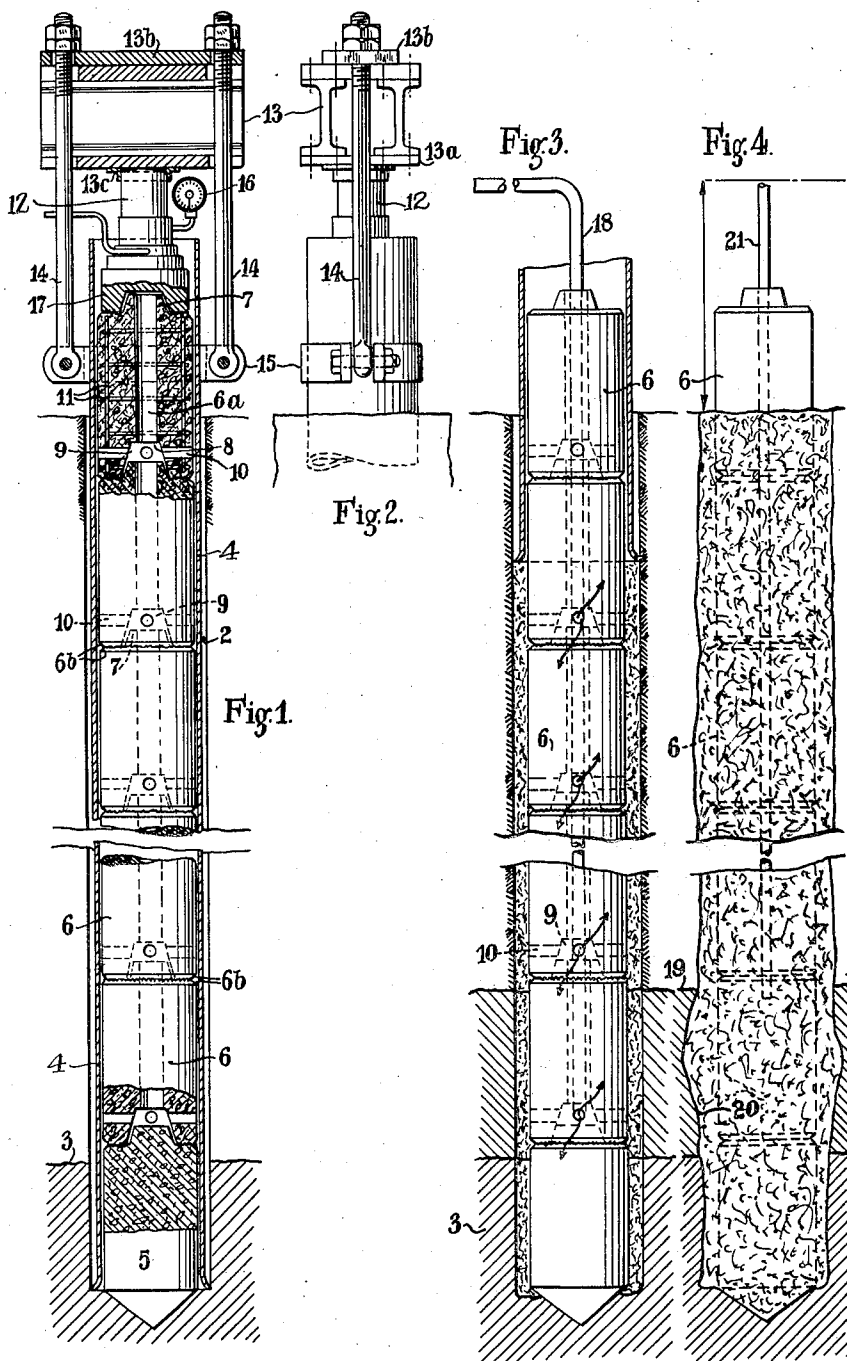
Nov. 6, 1934.

A. HOOD

1,979,547

CONSTRUCTION OF "IN SITU" CONCRETE PILES

Filed Aug. 15, 1932



INVENTOR
ANDREW HOOD,

BY
Paulmin & Paulmin
ATTORNEYS

UNITED STATES PATENT OFFICE

1,979,547

CONSTRUCTION OF "IN SITU" CONCRETE PILES

Andrew Hood, London, England

Application August 15, 1932, Serial No. 628,870
In Great Britain August 24, 1931

6 Claims. (Cl. 61—57)

This invention relates to the construction of "in situ" concrete piles and has for its object to provide an improved process and apparatus for the construction of such piles and an improved
5 pile.

According to this invention precast units are employed being adapted to be built up "in situ" to form the pile, the process consisting in boring and lining the bore with metal casing in any well known
10 manner, inserting one or more precast hollow concrete units to form a hollow column within the metal casing, supplying grout under pressure to the hollow core and withdrawing the metal casing either before or as the grout fills the core.

The metal casing may be sectional and the hollow concrete units may be reinforced, a small clearance being left between the unit and the casing. Passages may be formed or provided communicating between the hollow core and the
15 outer surface of the column. The grout may be supplied to the hollow core through a tube introduced down the core leading to the bottom. The metal casing may be progressively withdrawn as the grout fills the core or may be withdrawn in
20 stages.

The invention further consists in the process of applying a load to the precast pile composed of a single unit or several units whilst freely positioned within the casing and before the introduction of the grout, by which means the foundation
25 stratum beneath the toe unit is consolidated, the toe unit bedded in, and the bearing capacity of the foundation stratum can be tested.

The invention further consists in the method of utilizing the natural resistance of the sectional metal casing to withdrawal for applying the test
30 load to the column. After the above processes have been carried out and after the introduction of the grout but before it is set, the column may be subjected to the application of a load so as to ensure continuity of the column and absence of voids.

One or more metal rods may be introduced into longitudinal passages formed in the precast concrete units either before or after the introduction of the grout. The said metal rods may be introduced for the whole or part of the length of the pile for the purpose of bonding the units together, and the rod may extend above the pile to bond
35 the pile with the cap or other superstructure.

A precast concrete unit for use in the processes above described has joggled or dovetailed ends adapted to interlock with the adjacent unit when in position and is provided with one or more longitudinal passages and one or more transverse
40 45 50 55

passages leading from the longitudinal passages to the outer surfaces of the unit through which the grout may be introduced. The precast concrete units are preferably reinforced individually by metal reinforcements in any well known manner.
55 60 A different form of toe unit may be employed if desired and this may be formed of solid concrete precast and reinforced, the upper end being dovetailed or joggled to co-act with the next precast unit while the lower end is suitably shaped to provide a good weight contact with the stratum in which it is founded.

It will be understood that when the pile is completed the precast units are sheathed in grout concrete and in order to ensure a more perfect keying between the sheath and the units the edges of the units may be rounded or chamfered to provide a key for the grout at the junction of the units.

One form of precast unit made in accordance with this invention consists of a hollow or cylindrical reinforced concrete body having a rib or projection on the upper surface and a recess on the lower surface. The rib or projection and the recess may be slightly tapered, the recess at the bottom of one unit being adapted to engage and be located on the rib or projection at the top of the lower unit. The recess is deeper than the rib or projection and thus provides a reservoir for grout and accommodation for attaching the lowering device. A series of transverse passages communicate between the outer surface of the unit and the reservoir through which the grout introduced down the bore of the unit will find its way into the drill bore and form a concrete sheath surrounding the unit.
65 70 75 80 85 90

Referring to the drawing filed herewith which illustrates the construction of one form of "in situ" concrete pile made in accordance with one process according to this invention—

Figure 1 is a sectional elevation showing one form of pile being made in the boring.

Figure 2 is an elevation of the upper part of Figure 1 taken at right angles thereto.

Figure 3 is a part sectional elevation through the same boring at a different stage of construction.

Figure 4 shows a section through the same boring with the pile completed.

The following is a description of the construction of one form of "in situ" concrete pile made in accordance with one process according to this invention.

Boring.—A boring 2 is made to the required bearing stratum 3 by the usual methods and tools
95 100 105 110

employed in well boring. The hollow steel casing 4 is sunk to the full depth. The diameter of the hole bored is governed by the greatest external diameter of the pilot or leading section of the casing. Samples of the strata are obtained from the core extracted and preserved for examination. When bearing stratum 3 is reached the formation of the pile is commenced.

Forming the pile.—With the steel casing 4 sunk to the full depth of the bore the process of forming the built up body of the pile is commenced by introducing through the hollow casing 4 a solid precast toe unit 5 to engage with the bearing stratum 3. This done, the building up of the shaft of the pile is done by lowering a succession of hollow precast units 6 adapted to form the column of the pile. The form of precast concrete units 6 illustrated each consists of a hollow cylindrical concrete body portion having a central bore 6a extending from top to bottom, a spigot 7 on the upper surface and a socket 8 on the lower surface. The sides of the projection 7 and recess 8 are slightly tapered, the recess at the bottom of one unit engaging the projection on the unit below. The depth of the recess 8 is greater than the height of the projection 7 so that a reservoir 9 is formed for grout. The recess may also be used for engaging the lowering means which of course has to come away after the unit is in position. Transverse passages 10 formed in the body portion communicate between the reservoir 9 and the outer cylindrical surface of the unit through which grout introduced down the bore 6a of the unit will find its way into the casing 4 and also into the bore 2 as the casing 4 is withdrawn. The body portion is reinforced by metal rods 11 in the usual manner. The top and bottom edges are chamfered at 6b to form a keying groove for cement at the junction of the units and the outer surface is preferably cast rough or grooved. The external diameter of the concrete units 6 is slightly less than the internal diameter of the casing 4. Thus there is built up a concrete column of any desired length forming the body of the pile. The lowering of the precast units may be done by means of any convenient apparatus or by a specially designed lowering apparatus.

The next operation is to apply to the top of the built up concrete column a load which is obviously transmitted without any appreciable loss to the toe unit of the pile, thereby consolidating the foundation stratum and bedding in the toe unit. This is preferably done as illustrated by means of an hydraulic jack 12 acting on a cross head consisting of two H section joists 13 secured between two plates 13a, the upper plate bearing against a loose washer plate 13b, supported by rods 14 from a collar or gland 15 clamped onto the top section of the casing 4, the lower plate 13a having circular socket 13c secured thereto for positioning the jack 12. The plates 13a extend the full length of the H section joists and are slotted at the ends to admit the rods 14. The withdrawal resistance offered by the steel casing 4 is thus utilized to impose on the column of units a positive load which in practice may vary from approximately 30 to 60 tons according to the length of the casing and the nature of the sub-strata encountered. The jack is provided with a gauge 16. If the reading is maintained, then it indicates that the pile has not settled and that the foundation stratum is capable of bearing the load applied plus the weight of the pile. Thus a total load equal to the resistance of the casing to extraction plus the weight of the built up con-

crete column may be imposed on the foundation stratum at the toe unit 5 of the pile and measured on a gauge attached to the jack. A special helmet 17 is preferably employed between the base of the jack 12 and the top of the uppermost precast concrete unit 6.

Pressure is maintained on the hydraulic jack until the required load is imposed on the precast concrete column or until the steel casing commences to lift; then the extraction of the casing is continued as hereafter described by power exerted from the boring tackle (not illustrated), the jack being removed for the time being.

The next operation is to apply a process of cementing to the built up concrete column which for the time being is partly supported by the steel casing 4 and this is done as follows:—

A sectional pipe 18 (see Figure 3) is lowered through the central bore 6a of the column of precast concrete units until its bottom end just reaches the grout reservoir 9 immediately above the toe unit 5 and through this pipe cement grout is introduced under any desired pressure. The grout is forced through the transverse passages 10 into the space between the column of the built up pile and the adjacent sub-strata. During the process of cementation the casing 4 and the sectional pipe 18 are both progressively and methodically lifted or extracted until the whole of the body of the pile has been surrounded and filled with grout.

Thus the bore 6a of the pile and all voids are filled and a valuable sheath of grout is formed around the pile for its full length engaging and combining with the adjacent strata.

The top and bottom edges of the precast units being chamfered at 6b form a V shaped key at their junction providing an effective key for the grout when set.

Where the bearing or upper stratum is of a permeable nature such as ballast or sand the grout under pressure will engage with the strata and form large collars or thickenings on the pile. In Figure 4 is shown a permeable stratum 19 which has resulted in a thickening 20 being formed on the finished pile.

Before the steel casing 4 is entirely extracted the hydraulic jack is preferably again applied to ensure that the precast units are all rammed tightly together.

The process of cementation now completed, a steel rod 21 acting as a splice or developing bar is inserted down the bore 6a in the soft grout to any required depth, part of the rod 21 being left projecting from the top of the column.

After the lapse of sufficient time the grout will have set and be incorporated in the finished pile. Thus it will develop high skin friction with the strata and also be securely keyed to the precast shaft.

The finished pile constructed as above described and ready to take its superimposed working load possesses the unique features in the first case of having been subjected to an adequate and measured test load; such a test is obviously more informative and reliable than the old method of judging the bearing capacity by measuring the shoe resistance to penetration of a driven pile hammered to a set, and, in the second case the load carrying capacity of the pile is substantially further increased since the test load has been applied before the skin friction is developed between the surface of the grout skin and the strata.

Some of the novel features and outstanding ad-

vantages obtained by this invention are as follows:—

(a) The need for testing completed piles is definitely unnecessary, expensive test loads and other heavy expenses in this connection being eliminated.

(b) Supervision of the piling by engineers, architects or other interested parties is reduced to a minimum since all the operations are positive and convincing; saving of expense in this connection.

(c) Piling in waterlogged ground is no detriment to this system; in fact, the presence of water is a help in the process, providing freer action of the cementation.

(d) The piles are subjected to a substantial test load during the process, indicating the load bearing capacity of the sub-strata and, in addition, the developed skin friction enhances the load bearing capacity of the completed piles to a very high degree.

(e) The intrinsic strength of the piles is obtained as desired without the use of heavy and costly continuous steel reinforcement.

(f) Piles can be formed with a minimum headroom of approximately 6 feet inside or around buildings with no danger, vibration, noise or other disturbances to adjacent or adjoining premises.

(g) If necessary, the process of forming the piles can be stopped at any stage and recommenced later at will without detriment to the pile when completed.

(h) Piles can be formed raking or vertical as desired.

(i) The length of the piles required can be predetermined almost exactly on inspection of the samples of sub-strata revealed by boring.

(j) There is a minimum of space required for carrying out the process and the elimination of operation dangerous to workmen.

(k) Cementing under pressure of pile shaft ensures absence of voids and close contact with sub-strata.

What I claim and desire to secure by Letters Patent is:—

1. The process of forming "in situ" reinforced concrete piles consisting in boring and lining the bore with metal casing forming a hollow column within the metal casing, supplying grout under pressure to the hollow column and withdrawing the metal casing.

2. The process of forming "in situ" reinforced concrete piles consisting in boring and lining the bore with sectional metal casing, forming a hollow concrete column within said casing having a small clearance and passages communicating between the inner and outer surfaces of the column, supplying grout under pressure to the hollow column through a tube leading to the bottom of the column and progressively withdrawing the metal casing and tube as the grout fills the column and is expressed through the said passages to fill the voids surrounding the column.

3. The process of forming "in situ" reinforced concrete piles consisting in boring and lining the bore with metal casing, forming a hollow column within the metal casing, applying a load to the hollow column whilst freely positioned in the casing, supplying grout under pressure to the hollow column and withdrawing the metal casing.

4. The process of forming "in situ" reinforced concrete piles consisting in boring and lining the bore with metal casing, forming a hollow column within the metal casing, applying a load to the column whilst freely positioned in the casing, supplying grout under pressure to the hollow column, withdrawing the metal casing, and applying a load to the column after the introduction of the grout, but before it has set to ensure continuity of the column and absence of voids.

5. A concrete pile comprising a plurality of hollow precast concrete units assembled end to end and totally ensheathed and filled with grout.

6. A concrete pile comprising a plurality of hollow precast concrete units assembled end to end and filled with grout, the whole being totally ensheathed with grout to which is bonded a layer of aggregate from the surrounding strata into which the grout has permeated under pressure.

ANDREW HOOD.

50

125

55

130

60

135

65

140

70

145

75

150