N. C. JOHNSON.

ART OF MAKING CAST-IN-PLACE CONCRETE PILES AND THE LIKE.

APPLICATION FILED JUNE 4, 1915.

1,173,807. Patented Feb. 29, 1916.

Fig 1.

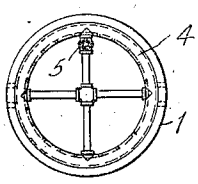


Fig 5.

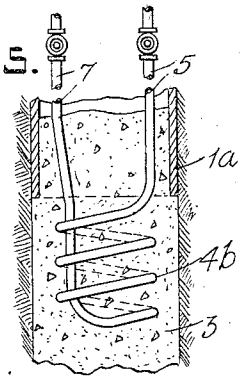


Fig 6.

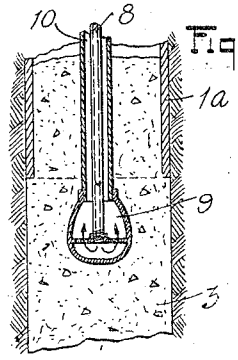


Fig 2.

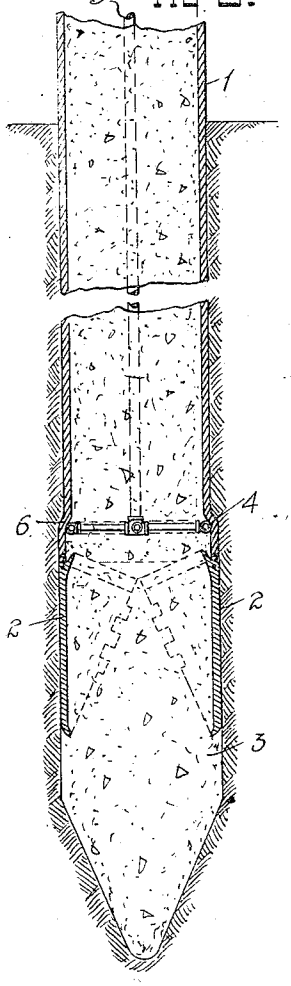


Fig 3.

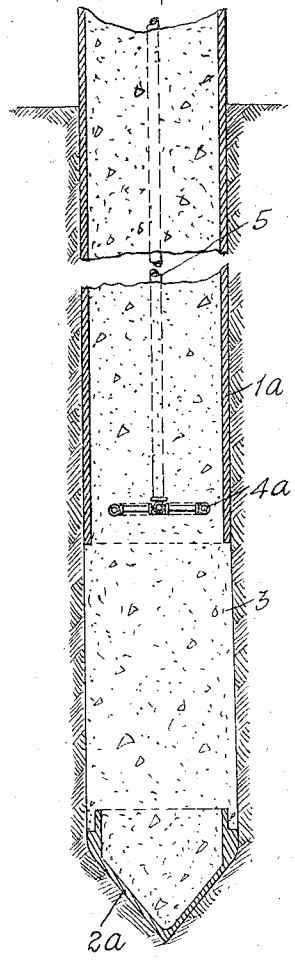


Fig 8.

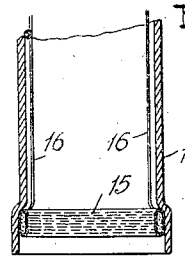


Fig 4.

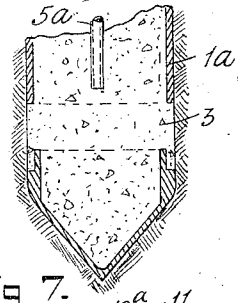
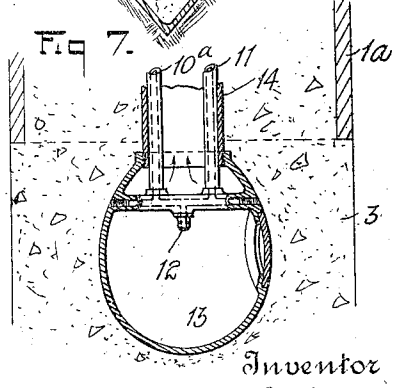


Fig 7.



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ART OF MAKING CAST-IN-PLACE CONCRETE PILES AND THE LIKE.

1,173,807. Specification of Letters Patent. Patented Feb. 29, 1916.

Application filed June 4, 1915. Serial No. 32,175.

To all whom it may concern:

Be it known that I, NATHAN C. JOHNSON, a citizen of the United States of America, and a resident of Englewood, county of Bergen, and State of New Jersey, have invented a certain new and useful Art of Making Cast-in-Place Concrete Piles and the like, of which the following is a specification.

My invention relates to improvements in the art of making cast-in-place concrete piles.

My invention is particularly applicable to that method of forming and placing concrete piles, wherein a suitable casing is driven into the ground, is then filled with plastic concrete and then the casing is withdrawn. Heretofore difficulty has been experienced, in this method of pile driving, due to the fact that the inward pressure, or back pressure, so called, of the surrounding earth, pinches off or squeezes aside the plastic concrete before it has had time to harden, so that the continuity of the concrete pile or column is interrupted. My invention comprises improvements in methods of casting and placing such piles, and particularly in the hardening of the concrete of such piles, and improvements in apparatus for placing or forming such piles.

The object of my invention is to cause the concrete of such piles to set very rapidly and thereby to avoid pinching off or squeezing aside of the concrete, as hereinbefore referred to; and to do this in a simple manner and by simple means.

I will now proceed to describe my invention with reference to the accompanying drawings, in which various forms of apparatus adapted for carrying out the method portion of my invention and embodying the apparatus portion of my invention, are illustrated, and will then point out the novel features in claims.

In said drawings: Figure 1 shows a top view of a pile-casing provided with heating means adapted for the carrying out of my invention, and Fig. 2 shows a central vertical section of the same, the casing being shown as provided with an "alligator" point, and being shown as partly raised. Fig. 3 shows a central vertical section of an alternative form of heating apparatus, the view also showing the use of a plain point instead of an alligator point. Fig. 4 is a fragmentary vertical section similar to Fig. 3, and illustrating use of a still further form of heating apparatus. Fig. 5 is a view, similar to Fig. 4, illustrating a still further form of heating apparatus. Figs. 6 and 7 are views similar to Fig. 4, and illustrating still further forms of heating apparatus. Fig. 8 is a central vertical section of a casing with an electrical heating device within it.

In the art of making cast-in-place concrete piles of the type known as the "simplex" pile, it is customary to drive into the ground a pipe or casing of appropriate diameter, furnished either with a solid point, or with a point known as an alligator point, at its lower end. After driving to a proper refusal or penetration, the pipe is filled with plastic concrete and gradually withdrawn from the ground by means of tackles. The plastic concrete then flows from the lower end of the pipe, the solid point, if used, becoming detached from the pipe and being left permanently in the ground; while if the alligator point has been used, the jaws open, leaving substantially a free passage for the plastic concrete; such concrete, in either case, filling the space occupied by the casing previous to its withdrawal. This type of pile is, however, open to the very serious objection that the inward pressure, or back pressure, so called, of the surrounding earth, often pinches off, or squeezes aside, the plastic concrete, before it has had time to harden, so that the continuity of the concrete pile or column is interrupted.

It is a property of Portland cement concrete that, while under ordinary conditions of temperature it becomes rigid at a period varying from one to three hours after its admixture with water, this period will be very much shortened if the temperature of the mass be raised well above ordinary atmospheric temperatures, the concrete setting the more rapidly the higher the temperature is raised.

My invention comprises a method of and means for raising the temperature of the concrete approximately at the time of its

issuance from the lower end of the driven pipe or casing, the application of the heat being progressive throughout the length of the concrete column as the driven casing is withdrawn.

For applying heat to the concrete, I may inject steam into the concrete, through a suitable pipe, which initially is lowered to near the bottom of the casing and then is withdrawn, either with the withdrawal of the casing or independently, thereby applying heat progressively, first to the concrete at the bottom of the hole and then upward. The steam, so ejected into the mass of liquid concrete, is condensed, so that not only the sensible heat of the steam, but also the latent heat of the steam is utilized for heating the concrete; the water formed by the condensation of the steam supplying in part the water required for setting of the concrete. Or, steam, of the water or other suitable heating fluid, may be circulated through a pipe coil and then discharged outside of the hole; or, a suitable gas or liquid fuel burner may be operated within the concrete; or an electric heater may be used as the heating means; in fact, any suitable means for applying heat may be employed.

In the arrangement shown in Figs. 1 and 2, 1 designates a driven tube or casing, such as is commonly employed in forming and placing piles of the type described, 2—2 designates segments of a so-called alligator point, 3 designates a mass of concrete within the hole and tube, 4 designates an annular perforated steam pipe, and 5 a pipe for the supply of steam to such annular pipe 4. In Fig. 2 the tube 1 is shown as partly withdrawn, the alligator point having opened and allowed the concrete within the tube to fill the hole. The particular type of casing tube 1 there shown is provided near its bottom with a shoulder 6, and the annular steam pipe 4 is shown as located underneath such shoulder so that it receives some protection from the said shoulder. It will be obvious that as the tube 1 and the steam pipes 4—5 are drawn up, steam will be supplied successively to all portions of the concrete; thereby greatly hastening the set of the concrete as already stated. But while, under the influence of heat applied as described, the concrete sets very rapidly, yet it does not set so rapidly as to prevent the withdrawal of the tube 1 with its point 2 and the steam pipes.

It is not necessary to use a driven tube having an alligator point, or a driven tube having a shoulder forming a protection for the steam pipe 4. In the arrangement shown in Fig. 3, a plain point, 2^a, for the tube 1^a, is shown, this point remaining at the bottom of the hole when the tube 1^a is removed; and this tube 1^a is shown as a plain tube, the steam supply annulus 4^a being also shown as of considerably smaller diameter than the driven tube 1^a. It is obvious that this steam annulus might have any suitable diameter. Under some conditions it may be advisable to have the steam discharged close to the walls of the driven tube 1^a, while under other conditions it may be advantageous to have the steam discharged into the concrete more near the center of the mass of concrete, so that the steam is distributed more evenly through the concrete. It is not necessary to use a steam discharge annulus, as shown in Figs. 2 and 3, but the steam may be discharged from the open lower end of the straight pipe 5^a, as indicated in Fig. 4. In fact, any suitable means may be used for distributing the steam, or no particular means whatever for distributing the steam may be employed, and I do not limit myself to the use of means for distributing the steam, or to any particular means for so distributing the steam.

In the arrangement shown in Fig. 5, a heating coil 4^b is provided, having both a supply pipe 5 and a discharge pipe 7; and either steam, or hot water, or any other suitable heating fluid may be circulated through this coil 4^b and thence outward. The arrangement shown in Fig. 5 has the advantage that the temperature of the heat fluid may be regulated very accurately and through a wide range, and thereby localized heating to a temperature possibly higher than desirable, under some conditions, is avoided.

In the arrangement shown in Fig. 6 there is a gas-and-air supply pipe 8 leading to a combustion chamber 9, the products of combustion passing off through a pipe 10 surrounding this combustion chamber. In the arrangement shown in Fig. 7 there is an oil supply pipe 10^a and an air supply pipe 11, the pipe 10^a having in its lower end a liquid fuel burner 12, the fuel jet from this burner, and the air from the pipe 11, mixing within the combustion chamber 13 and burning there, the products of combustion passing off through the discharge pipe 14.

In the arrangement shown in Fig. 8 an electric heater 15 is employed, the current being supplied to this heater through leads 16.

In general, it may be said that my invention is independent of any particular means for applying the heat.

It is not necessary even to use a solid driven tube of the type shown. It is quite practicable to drive a collapsible mandrel, thereby forming in the earth the hole for the pile, to pour the concrete through the mandrel into the hole, and then to withdraw the mandrel. In a companion application filed June 4, 1915, Serial No. 32,173, I have illustrated one suitable type of mandrel for this purpose. Heating means may be inserted into the hole formed by the use of that man-

drel or any other suitable mandrel either interiorly or exteriorly, and heat applied to the concrete and that heating means withdrawn either with the withdrawal of the mandrel, or before or after the mandrel is withdrawn. Similarly, in the arrangements shown in the various figures of the accompanying drawings, the driven tube may be withdrawn before the withdrawal of the heating means, if desired.

It is at once evident that if the heat is applied substantially at the exterior surface or layers of the concrete as it issues from the pipe and fills the hole, that these exterior layers will be raised in temperature to the point necessary to secure consolidation of the material, leaving the interior without substantial increase in temperature. By this means a hard outer layer is formed leaving the interior of the concrete in a plastic state, the outer layers so hardened being of sufficient strength to withstand the inward pressure of the earth and prevent the squeezing off of the pile or column in the manner before set forth. Such an arrangement would effect a great economy of heat over that in which the hole may be uniformly heated.

What I claim is:—

1. The herein described improvement in the art of forming cast-in-place concrete piles, and the like, which comprises forming a hole, placing fluid concrete therein, and then applying heat to such concrete from the lower portion thereof progressively upward.

2. The herein described improvement in the art of forming cast-in-place concrete piles and the like, which comprises forming a hole, placing fluid concrete therein, and applying heat progressively to the exterior portion of such concrete from the lower portion upward and thereby forming quickly a hard exterior pile.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

NATHAN C. JOHNSON.

Witnesses:
H. M. Marble,
D. A. Davies.