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METHOD AND DEVICE FOR CONSTRUCTING PILES

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FIG. 1.

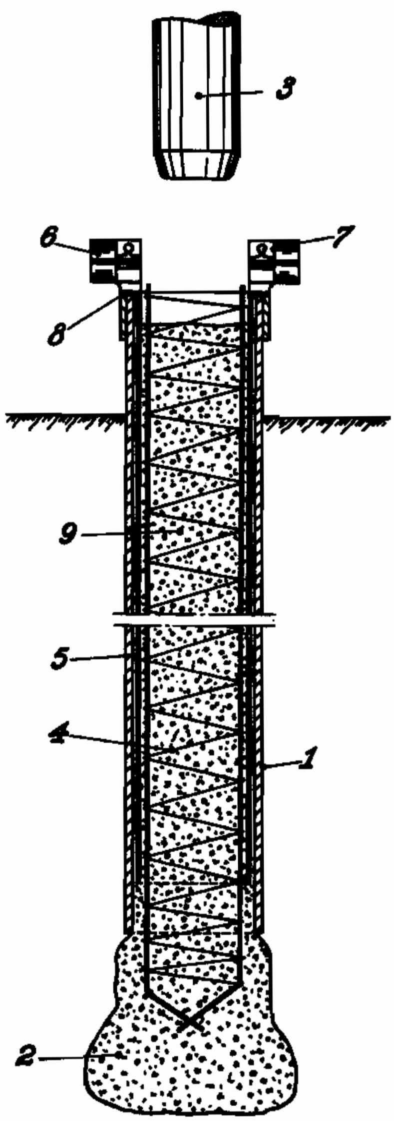


FIG. 2.

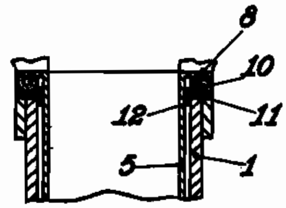


FIG. 3.

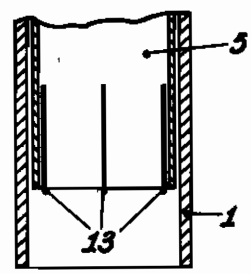
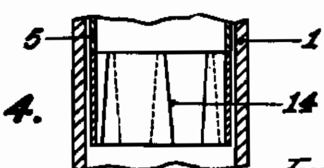


FIG. 4.



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ALIEN PROPERTY CUSTODIAN

METHOD AND DEVICE FOR CONSTRUCTING CONCRETE PILES MOULDED IN THE GROUND

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My invention relates to a method and device for constructing reinforced or non-reinforced concrete piles moulded in the ground by the aid of one or more preparatory tubes and has essentially for its object to utilize rationally, in the course of concreting the pile, the weight of the concrete poured into the preparatory tube, in order to increase the pressure of the concrete at the base of the said tube and to oppose efficiently the thrust from the earth that tends to cause a strangulation or even a shearing, of the pile shaft.

With this end in view and according to my invention, the feed of the concrete into the excavation previously formed in the ground by sinking one or more preparatory tubes is effected through the interior of an auxilary tube arranged with lateral play inside the preparatory tube, the said auxiliary tube having imparted to it quick longitudinal vibrations, so that the friction between the auxiliary tube and the concrete therein is practically annulled. The pressure at the base of the preparatory tube may be further increased by loading the concrete in the vibrating tube, for example with a rammer monkey or with compressed air pressure applied to the inside of the vibrating tube. In the further course of the method, the auxiliary tube, which is kept on vibrating, may be readily withdrawn in measure as the preparatory tube is being raised, while the concrete in the vibrating tube continues to exert the pressure at the base of the preparatory tube.

According to my invention, the vibrating tube preferably consists of a thin sheet metal tube extending with very small lateral play inside the preparatory tube and having imparted to it quick longitudinal vibrations, such as by means of one or more electric motors including an unbalanced weight and arranged on the vibrating tube, or by any other means. The vibrating tube may extend over the whole length of the preparatory tube or over a portion thereof and may have an outer flange or lug whereby to bear on the upper end of the preparatory tube, advantageously with a layer of elastic material interposed between the said lug and the said end.

As a result of the quick vibrations imparted to the auxiliary tube and which eliminate the friction between the latter tube and the concrete, a layer of substantially fluid cement paste is formed between the concrete and the said tube, which paste lubricates the latter and further facilitates the reciprocation and the withdrawal of the said auxiliary tube. Moreover and since the outer surface of the vibrating tube is free from any contact and, consequently, from any friction, it will be understood that the vibrating tube, which, in addition, may be of very little weight, can be vibrated at a very small expense of energy. Further, the vibrations are not transmitted to the surrounding ground, so that the danger of rendering the ground more mellow and thus increasing its tendency to cause strangulation of the pile is eliminated.

Owing to the design and arrangement of the vibrating tube, the means for producing the vibrations, such as the aforesaid electric motors including an unbalanced weight, may be provided at the upper end of the auxiliary tube and will nevertheless secure a perfect transmission of the vibrations over the whole length of the auxiliary tube.

Such results cannot be obtained by the known methods in which the preparatory tube is being imparted heavy blows or shocks such as by means of a steam hammer, the upwardly directed shocks being intended to cause every time the deposition of a certain quantity of concrete in the excavation formed by driving the preparatory tube, while the downward movements of the said tube serve to ram the concrete, preferably by means of an outer annular lug provided at the lower end of the tube. The said blows are applied at the relatively slow succession that may be obtained from a steam or pneumatic rammer (of the order of 60 to 200 blows per minute); the blows consequently act in a non continuous manner; they need be of great strength and great amplitude (several centimetres), since they are intended to overcome every time the friction between the preparatory tube and the concrete on the one hand, and between the said tube and the surrounding ground on the other hand, and since they serve for causing the progressive withdrawal of the preparatory tube and for effecting the ramming of the concrete. The principle of the known method is therefore essentially different from that of the present invention, since the old method does not eliminate the friction between the tube and the concrete, but overcomes such friction at every blow through applying to the preparatory tube an impulse which generates a force of inertia greater than that resulting from the friction between the concrete and the walls of the tube. Setting up shocks in the known method requires a high consumption of energy, which is due, among others, to the fact that the preparatory tube is necessarily heavy and that the frictional resistances to be overcome are very high. Moreover, the known method does not make it possible to rationally oppose the pressure of the earth at the base of the preparatory tube, for the reason that the mass of concrete is not freed in a continuous manner from the tube, so that no advantage is taken from the weight of the concrete as far as opposing the continuous thrust from the earth is concerned.

In the method according to my invention, the friction between the concrete and the walls of the tube that contains it is invariably eliminated owing to the continuously acting high frequency vibration.

Simply by way of example, one way of carrying out the method of the invention will be hereinafter described with reference to the accompanying drawing, in which:

Fig. 1 is an axial section of a preparatory tube having associated therewith an inner vibrating tube, in the course of concreting a vertical foundation pile, and

Figs. 2, 3 and 4 are fragmentary sectional views showing three alternative embodiments of the vibrating tube.

The preparatory tube 1 is driven into the ground up to the desired depth in any convenient way. Thereupon, an enlarged footing 2 may be formed by ramming the concrete with the monkey 3. After the footing has been concreted and prior to starting with the concreting in accordance with the new method, a portion of the pile shaft may be formed by the known method of ramming concrete in the ground. If desired, a reinforcement 4 may be placed in the tube and have its lower end anchored in the concrete.

The tube 1 has arranged therein with small lateral play (for instance about ten millimetres) an auxiliary tube 5 made from thin sheet metal and having its upper end extending up to a point above the upper end of the tube 1, while its lower end extends up to the proximity of the lower end of the said tube 1. The tube 5 is provided with means 6, 7 for imparting thereto quick vertical vibrations, which means may consist of a small pneumatic monkey or of one or more electric vibrators secured in any way to the vibrating tube.

To effect the concreting of the pile, a quantity of concrete 9 is charged into the auxiliary tube 5, preferably so as to fill up the latter, and may even correspond to the amount of concrete necessary for constructing the whole of the pile. Use may be made of relatively moist concrete such as would readily ensure a perfect encasing of the reinforcement. The tube 5 has then imparted to it quick vertical vibrations of small amplitude, with the result that all adhesion between the tube 5 and the concrete 9 is eliminated, so that the latter in fact forms a free column the total weight of which acts at the base of the preparatory tube, i. e. upon the portion of pile already moulded in the ground, and opposes efficiently the thrust from the earth. Hence, the tube 5 may be moved without friction with respect to the concrete 9 and, consequently, may be readily raised. The raising may be effected by any convenient means, in measure as the preparatory tube 1 is withdrawn, which may be done for example by means of the usual cables. The tube 1, being not in contact with the concrete 9, can be withdrawn at a smaller consumption of energy than in the known methods.

The vibrations of the tube 5 are not intended to raise the latter; they are of equal amount in both directions and of very small amplitude, for instance, a few tenths of a millimetre, while their frequency should be very high, and, more specifically, sufficiently high—for example of the order of 1000 to 6000 per minute—for eliminating practically all friction between the concrete 9 and the tube 5.

The tube 5 may be inserted into the tube 1 after the latter has been driven to the desired depth and after the enlarged footing has been formed; alternately, the tube 5 may be placed in position before the driving action is started.

The tube 5 may be set in vibration as soon as the first batches of concrete are introduced; it may then be raised up to a certain height before the total quantity of concrete necessary for constructing the pile is poured into the tube. If desired, the head of concrete 9 may be subjected to a load during vibration, for example by placing thereon the monkey 3 or by applying compressed air. In the latter instance, the vibrating tube need be suitably maintained, for example secured to the preparatory tube, in order to prevent the vibrating tube from being driven upwards under the effect of the air pressure; moreover, the upper end of the vibrating tube will be provided with a particular cap enabling the supply of compressed air.

A lug 8 of the vibrating tube may be arranged to bear upon the upper edge of the tube 1, so that the tube 5 will be raised simultaneously with the tube 1. The transmission of vibrations to the tube 1 may be prevented by interposing a washer 10 (Fig. 2) of elastic material, such as rubber or cork, between the upper edge of the tube 1 and the lug 8. The washer may be centered in position by means of an annulus 11 the web 12 of which projects into the interior of the tube 1, thus preventing the vibrating tube 5 from shifting laterally.

As shown in Fig. 3, a certain number of saw notches 13 may be cut over a relatively short longitudinal distance in the lower end of the tube 5. The latter tube being made from thin sheet metal, the flaps provided by notching are resilient and would open out under the action of the pressure of the concrete, so that, when the tube 5 is withdrawn, the concrete progressively spreads out in the excavation formed during the driving of the preparatory tube. If desired, the said flaps may extend up to a point below the preparatory tube.

Alternately, and as shown in Fig. 4, the vibrating tube may have secured to its lower end resilient flaps 14 of slightly trapezoidal shape, said flaps partially overlapping each other and widening out in the downward direction, it is to say, towards their free ends. When the tube 5 is empty, the said flaps extend in alignment therewith; when the tube is filled with concrete, the flaps are capable of spreading out slightly in the same manner and with the same object as the flaps obtained by notching the lower end of the auxiliary tube. Owing to their shape however, the trapezoidal flaps will provide a sufficiently tight joint with each other, whatever be the amount of spread-out.

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