Jan. 29, 1957 E. PICKMAN 2,779,161

METHOD AND DEVICE FOR CONSTRUCTING FOUNDATION PILES IN THE GROUND

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Fig. 1.

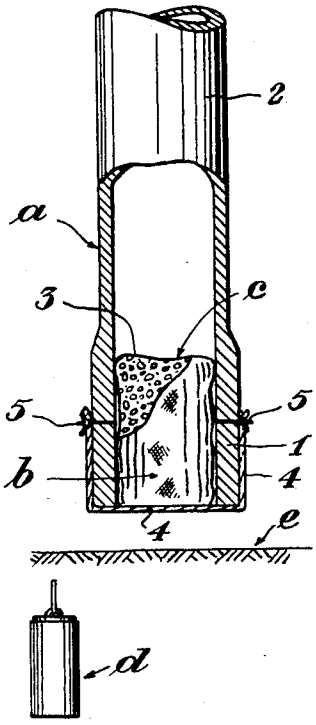


Fig. 2.

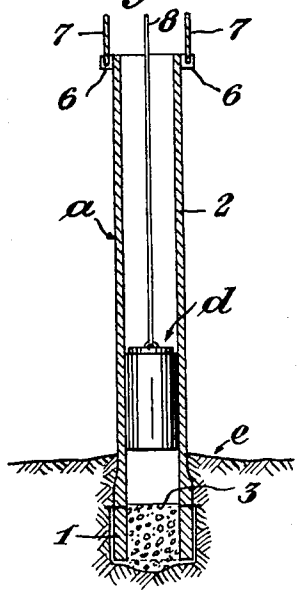


Fig. 3.

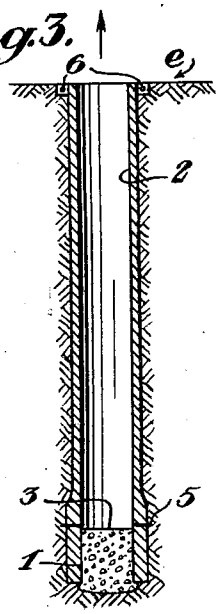


Fig. 4.

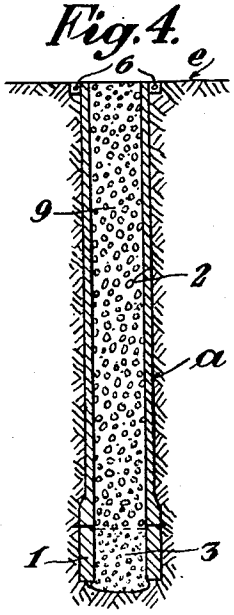
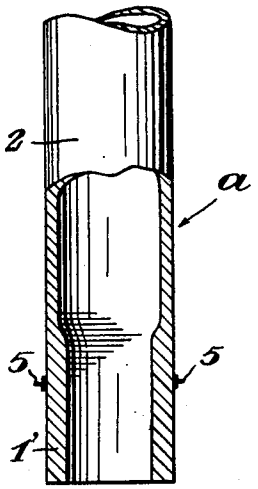


Fig. 5.



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Fig. 6.

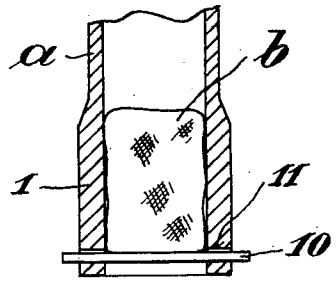


Fig. 7.

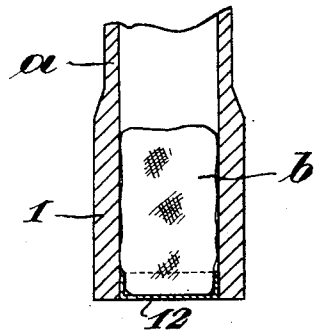
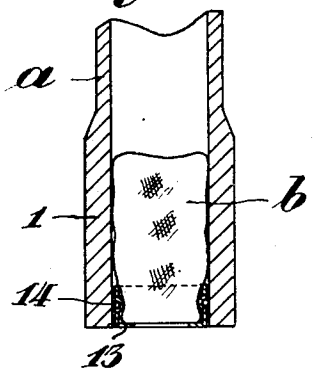


Fig. 8.



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METHOD AND DEVICE FOR CONSTRUCTING FOUNDATION PILES IN THE GROUND

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Application September 10, 1951, Serial No. 245,861

Claims priority, application Belgium September 15, 1950

6 Claims. (Cl. 61—57)

The present invention relates to an improved method for building up foundation piles in the ground, and to certain means for carrying out the method.

Methods are known in which the pile is constructed by driving into the ground a strong metal tube provided at its lower end with a plug of concrete or other similar material, on which repeated blows are then applied by means of a rammer, in order to cause the said tube to enter the ground simultaneously with the plug. Such known methods, in which the shaft of the pile is formed in proportion as the tube is withdrawn, are very efficient and do not give rise to any objection from the technical point of view; however, they have the disadvantage that they are not suitable for the construction of pilings on a less important scale, since they require a special mechanical equipment, both for driving and for withdrawing the tube, which equipment is of a great height and heavy weight, and is therefore difficult and expensive to displace.

The present invention aims to obviate those drawbacks by modifying the technique to some extent, so that the required equipment should be of substantially smaller height, general bulkiness and weight, while being of simpler construction and operation.

The novelty of the invention, which enables one to achieve the desired results resides essentially in that the amount of concrete or like material, necessary to form the plug is placed in a deformable wrapper, preferably from material of little strength, such as paper, and in that the wrapper thus filled is introduced into the lower end of the tube, which is then driven into the ground by ramming upon the said filled wrapper. According to the invention, the wrapper may be introduced through the lower end of the tube, thus eliminating the disadvantages resulting from pouring concrete or the like into the upper end of the tube, prior to driving same. Moreover, this will greatly simplify the action of measuring the amount necessary to form a plug capable of carrying down the tube into the ground under the effect of the blows from the rammer, owing to its frictional adherence to the tube.

According to a further feature of the invention, the tube is left in the ground, instead of being withdrawn as in the conventional systems.

It will be seen from the foregoing that the present invention has several objects, and one of the main objects is, as mentioned above, reducing the height, the general bulkiness and the weight of the equipment required for driving tubes and forming piles, which makes it possible to considerably reduce the cost of small pilings.

Another important object of the invention consists in simplifying the work of forming the pile, while speeding up same.

Other objects and advantages of the present invention will appear from the disclosure of a few examples of embodiments of the invention, which will be given hereinafter by way of illustration, with reference to the accompanying drawings, in which:

Fig. 1 is a fragmentary, longitudinal sectional view of a sinking tube provided with a plug at its lower end, such as it appears prior to being driven into the ground;

Fig. 2 is a similar view, at a smaller scale however, of the tube and plug assembly, after the tube has been driven into the soil to a certain amount by the action of a rammer.

Fig. 3 is a longitudinal sectional view of the same tube and the same plug, such as they appear at the end of the driving operation, but prior to forming the shaft of the pile;

Fig. 4 is a longtiudinal sectional view of the same assembly, but with the pile achieved, with no inner reinforcement assembly;

Fig. 5 is a longitudinal section of a modified embodiment of the sinking tube; and

Figs. 6, 7 and 8 are fragmentary longitudinal sections of three alternative embodiments of the lower end of the assembly.

Like references indicate like, similar or corresponding components throughout the figures.

As shown in Figs. 1 to 4, *a* indicates a metal tube of a length substantially equal to that of the pile to be formed, although, where the plug is partially expelled, which plug will be hereinafter referred to, such length may be somewhat smaller. The tube, which may be of uniformed thickness, is, according to the invention, of reduced thickness along its larger portion, the lower end **1** being alone given a thickness sufficient to resist the lateral loads involved during the ramming of the inner plug. As a result, the remaining portion **2** may be of quite reduced thickness, since it has not to bear high loads. The additional thickness mentioned above may be obtained by increasing the outer diameter, as shown in the example of Figs. 1 to 4 and/or by reducing the inside diameter. The tube of Fig. 5 shows such a reduced inner diameter, the outer diameter of its leading end **1'** remaining unchanged.

Within the above mentioned tube *a*, there is placed a wrapper *b* containing e. g. fresh and almost dry concrete or another suitable similar material **3**, which constitutes the plug *c* proper. The wrapper considered is suitably formed by a sack of paper, fabric or another similar material of sufficient strength to contain the material of the plug *c*, while being shufficiently fragile to enable it to get torn during driving, though, in fact, there is no objection to the wrapper being much stronger, while remaining deformable.

On the other hand, the wrapper is closed at its upper end, which faces inside the tube *a*. According to one practical embodiment which is particularly advantageous owing to the speed with which it may be carried out and to its economy, the envelope and the plug are maintained in the position shown in Fig. 1 prior to the beginning with the driving of the tube, by means of a series of wires, cables, cords, straps, or the like, **4**, which have their ends secured to studs **5** firmly driven into the end portion **1** of the tube (Fig. 1) or welded to that end (Fig. 5), and which are arranged after the manner of a basket bottom transversally to the lower opening of the tube *a*, so that they may support the corresponding weight. The wires or the like **4** may be provided in the number of two or more, according to the importance of the weight to be carried. Such system of jamming the plug and the wrapper may be replaced by any other suitable means associated with the tube and/or the wrapper and making it possible to support the weight of the plug temporarily, for instance rods **10** engaged in holes **11** provided in the lower end of the tube (Fig. 6).

The cords, straps or the like **4** may have their intermediate portion secured in advance to the bottom of

the wrapper. They may also be secured in advance to the tube, if they have sufficient elasticity to be spread apart during introduction. One may also use a cap **12** (Fig. 7) or a ring **13** (Fig. 8) engaged e. g. frictionally or with elastic pressure (for instance by means of an elastic split ring **14**, Fig. 8), within or upon the lower end of the tube. Such cap or ring, e. g. from sheet metal or a plastic material, will then be disengaged from the tube when the plug descends somewhat under the effect of the ramming.

As is generally the case in the said systems of pile making, the tube *a* is provided at its upper end with two ears **6** for engagement by the cords or cables **7** intended to carry the tube in the vertical position and, in a general way, to enable it to be handled. Moreover, Figs. 2 and 3 show the rammer or monkey *d*, suspended by means of the cable **8**, which, like the cables or cords 7, is attached to the jib or derrick of the conventional mechanism required for ramming piles. It will be noticed that the rammer *d* has a larger relative diameter than those usually employed in the known systems, since its diameter is only slightly smaller than the inside diameter of the tube *a*.

The various components being thus constituted and arranged, the formation of the piles according to the present invention will be carried out according to one of the preferred ways of carrying out the invention, as follows: In the first place, the rammer *d* will be entirely or partly buried in the ground *e*, which only required a small excavation. The tube *a* is then raised and placed upon the rammer, which is then attached to its cable **8**. The rammer is then raised, as is also the tube *a*, by applying a traction to the corresponding cables **7**. The wrapper *b* containing the concrete of plug *c* is then introduced into the lower end **1** of the tube and wires **4** are laid under the lower face of the wrapper by securing them to the supporting studs **5** so that they are arranged after the manner of a supporting cage under the wrapper and the plug. The tube and the plug are thus ready in view of starting with the driving and the forming of the pile. Such steps are performed according to generally known standards, though with a few important modifications due to the features of the introduced improvements. Under these conditions, ramming of the material of the plug *c* is started by causing the rammer or monkey *d* to fall several times from a certain height, without coming out completely of the tube *a*. As will be logical and known per se, the blows of the rammer upon the upper face of the wrapper and the plug compress very strongly the material from which the latter is formed, pressing such material tightly against the wall of the tube, to which it will firmly adhere. Under the effect of the blows from the rammer upon the plug, the latter will carry the tube with it owing to its frictional adherence thereto, thus causing the assembly to be progressively driven into the ground. In practice, the tube *a* will follow the plug without difficulty during the descent thereof into the ground. In several instances, the plug tends to protrude slightly from the lower end of the tube *a* during driving, which will cause the wires 4 to be torn or broken, without any prejudicial consequence, which wires, once they have fulfilled their initial function consisting in maintaining temporarily the plug and the wrapper in the tube, perform no useful duty and may disappear or be destroyed in any way whatsoever.

When the tube is fully driven in and occupies, together with the plug, a position such as indicated in Fig. 3, the rammer *d* is withdrawn, whereupon the space inside the tube is filled with an additional adequate quantity of concrete **9** as if the mould of a concrete column had to be filled. The latter step terminates the forming of the pile, which consists thus in a sheath formed by the tube *a* and a filling composed of the plug *c* and the complementary filling **9**.

It will be understood that the above method may include various changes and modifications while remaining within the scope of the invention. For instance, one may introduce first the wrapper into the tube from below and then the rammer from above. Moreover, the rammer may have a diameter noticeably smaller than the hollow of the tube. On the other hand, the tube *a* may be slightly withdrawn at the end of the driving in order to enable the plug *c* to be expelled to a small extent, which will be followed by the formation of a thickened foot similar to that achieved with the conventional method in which a plug of concrete or the like is introduced unwrapped, i. e. without a wrapper, through the upper end of the tube. Among the possible modifications, one may still quote those consisting in additionally ramming the complementary concrete 9, such ramming following the termination of driving the tube and the plug, and in introducing a reinforcement assembly from metal bars inside the tube *a* in order to reinforce the pile.

What I claim is:

1. In a method for constructing a foundation pile in the ground by means of a driving tube, introducing into the lower portion of the tube through the lower end thereof a deformable wrapper filled with a predetermined quantity of compressible loose material, releasably attaching the filled wrapper to the lower end of the tube, and subjecting the filled wrapper to ramming from inside the tube for forming a plug adhering to the tube and capable of sinking the tube under the action of continued ramming on the plug.

2. In a method for constructing a foundation pile in the ground, placing a rammer on the ground, placing a tube above the said rammer, attaching said rammer to the cable of a ramming device, raising the said rammer in said tube, introducing into the lower portion of the tube through the lower end thereof a deformable wrapper filled with a predetermined quantity of compressible loose material, and subjecting the filled wrapper to ramming from inside the tube for forming a plug adhering to the tube and capable of sinking the tube under the action of continued ramming on the plug.

3. In a method for constructing a foundation pile in the ground by means of a driving tube, introducing into the lower portion of the tube, through the lower end thereof, a deformable wrapper filled with a predetermined quantity of compressible loose material, and subjecting the filled wrapper to ramming from inside the tube for forming a plug adhering to the tube and capable of sinking the tube under the action of continued ramming on the plug.

4. In a method for constructing a foundation pile in the ground by means of a driving tube, introducing into the lower portion of the tube, through the lower end thereof, a deformable wrapper filled with a predetermined quantity of loose material, and subjecting the filled wrapper to ramming from inside the tube for forming a plug adhering to the tube and capable of sinking the tube under the action of continued ramming on the plug, slightly raising the tube after it has been driven to the required depth, maintaining the tube in this position, and continuing the ramming so as to partially expel the wrapper and to force the contained material laterally into the ground for forming an enlarged base for the pile.

5. In a method for constructing a foundation pile in the ground by means of a driving tube, introducing into the lower portion of the tube, through the lower end thereof, a deformable wrapper filled with a predetermined quantity of loose material, and subjecting the filled wrapper to ramming from inside the tube for forming a plug adhering to the tube and capable of sinking the tube under the action of continued ramming on the plug, driving the tube to the required depth into the ground and filling the tube with pile forming material.

6. A device for constructing a foundation pile in the ground, including a tube, and a ramming plug in the bottom end portion of said tube being in the form of a de-

formable wrapper filled with loose compressible material and being located in and substantially filling only a lower end portion of said tube, and releasable means for yieldably resisting movement of the plug out beyond the lower end of the tube, said releasable means including wirelike elements having their intermediate portions secured to the bottom of the wrapper, and attaching means provided on the tube for attaching the ends of the said elements thereto.

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