June 17, 1930. E. FRANKIGNOUL 1,764,948

METHOD FOR DRIVING LINING TUBES FOR MOLDING CONCRETE PILES IN THE GROUND

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Fig. 1.

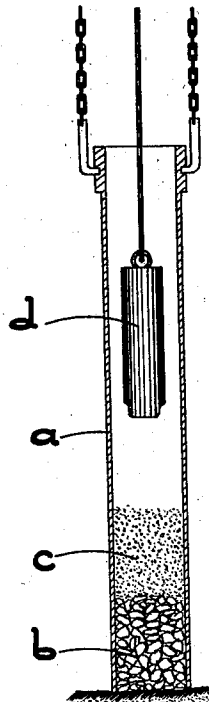


Fig. 2.

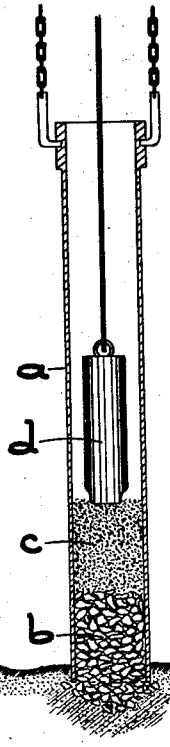


Fig. 3.

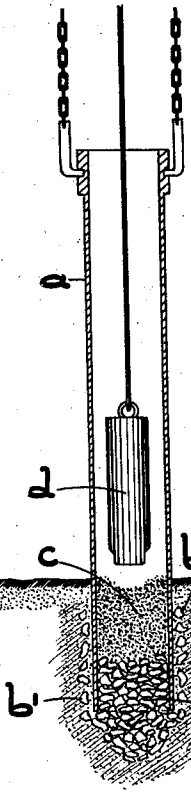
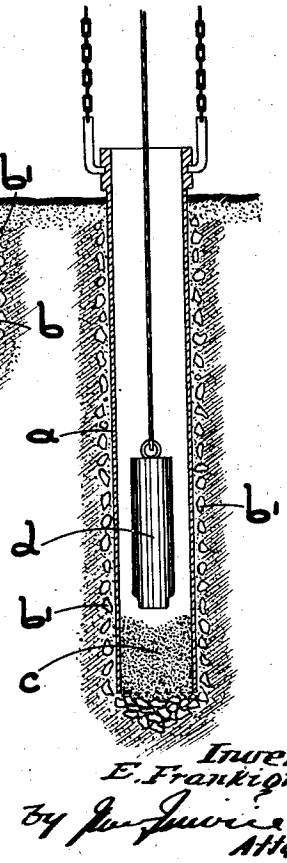


Fig. 4.



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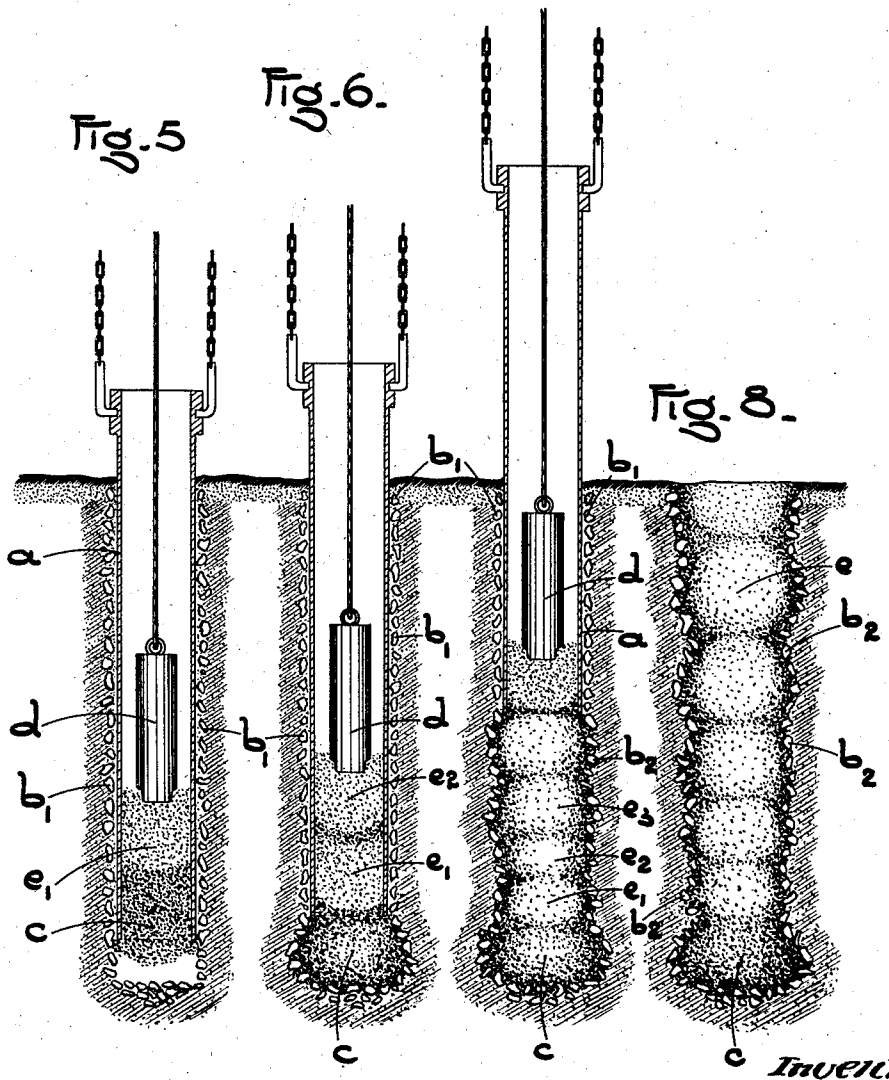
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Fig. 7.

Fig. 5

Fig. 6.

Fig. 8.



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1,764,948

UNITED STATES PATENT OFFICE

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METHOD FOR DRIVING LINING TUBES FOR MOLDING CONCRETE PILES IN THE GROUND

Application filed July 25, 1929, Serial No. 381,025, and in Belgium June 14, 1929.

Applications for patent have been made in the following countries: Belgium, June 14th, 1929; Luxemburg, June 18th, 1929; Belgian Congo, June 19th, 1929; Switzerland, June 19th, 1929; France, June 19th, 1929; Italy, June 22nd, 1929; Austria, June 22nd, 1929; Great Britain, June 25th, 1929; Spain, June 26th, 1929, of which the following is a specification.

My invention relates to the construction of concrete foundation piles in the ground particularly in soft or water bearing ground.

It provides for use to be made of an improved method which facilitates driving and withdrawing the lining tube while preventing water, mud or soil entering the interior of this tube.

According to this method a mass of broken stone or stones is first poured into the lining tube which is set up vertically upon the ground and then a mass of absolutely dry concrete, which is packed down by means of a ram having a frustoconical head, in such a manner as to compress the mass laterally against the wall of the tube.

In this way a fluid-tight plug of stony compressed concrete is formed which adheres sufficiently to the wall of the tube for the continual blows of the ram on this plug to cause the tube to be driven into the ground as far as the desired depth.

In this way all water, mud or soil is absolutely prevented from entering the tube above the plug during the driving operation.

At the commencement of the driving operation, the plug of concrete formed below the striking surface of the ram has first pushed into the ground a part of the mass of stones situated beneath it so as to form a kind of stony point.

By continuing to strike upon the said plug the latter carries along the tube, descends very slowly towards the lower end of the tube and gradually pushes out the mass of stones a certain number of which are forced out laterally and tear or separate the soil beneath the tube, that is to say produce a loosening which permits the tube to descend more easily.

The stones thus forced outwards become disposed in succession in the ground around the tube as the latter descends so as to produce a sort of stony sheath round the driven in part of this tube which considerably facilitates the sliding of the said tube in the ground.

When the tube has been driven to the desired depth, the plug is brought by gradual downward movement as far as the lower orifice of the said tube.

A certain quantity of fresh concrete is then poured above the plug and then the tube is raised by a few centimetres so as to leave a certain space beneath it and it is held in this position, after which the mass of fresh concrete is rammed energetically in order to drive the plug gradually out of the tube while keeping the lower orifice closed by this mass of fresh concrete.

A fresh quantity of concrete is then poured in and rammed and then the tube is again raised and so on, so that the body of the concrete pile is gradually mounted as the tube is extracted. The ramming action is continued at the lower part of the pile for a certain length of time so as to form a good wide base in the ground.

It is to be noted that the stones which are forced out laterally as the tube is driven in and which become encrusted in the ground so as to form a stony sheath, assist the tube considerably in sliding in the ground when it is raised in successive stages.

In addition, the successive operations of driving in concrete by ramming during the construction of the pile have the effect of spreading the ground laterally so that the stones which have previously become encrusted in it are pushed towards the concrete pile by the ground under compression and become partly encrusted in the pile so as to form upon the base of the said pile and over the whole of its height a succession of pronounced projections which form so many lateral anchorages in the ground and considerably increase the bearing capacity of the pile.

It is not always necessary to pour the concrete on to the plug and raise the tube gradually 2 to 3 cms. only at a time in order to drive

the plug out of the tube gradually. In this case the concrete is only added at the moment when the plug has almost completely left the tube. In dry earth the plug can be driven out with a single blow without taking special precautions in view of the absence of water and mud.

An embodiment of the above described process is illustrated in the accompanying drawings in which:

Figure 1 is the lining tube placed upon the ground and filled at its lower part with a mass of stones, pebbles or like material surmounted by a mass of dry compressible concrete.

Figure 2 shows the same tube after ramming and compression of the mass of concrete against the inner wall of the tube.

Figure 3 shows the same tube during driving, the concrete plug having descended slightly in the tube under the striking action of the ram while a part of the stones forced out laterally have become set in the ground outside the tube.

Figure 4 shows the same tube completely driven in.

Figure 5 shows the above mentioned tube slightly raised and after having received a charge of fresh concrete for expelling the plug gradually by striking with the ram.

Figure 6 shows the plug completely expelled, the enlarged base of the pile being already in formation.

Figure 7 shows the construction of the pile by driving in fresh concrete which has been poured in the tube, the stones which were previous forced out into the ground being pushed back by this ground so as to become partly encrusted in the column of concrete and form projections thereon.

Figure 8 shows the completely moulded pile with its stony projections.

In these figures, a is the tube, b the mass of stones, c the compressible dry concrete plug, b_1 the stones encrusted laterally in the ground, d the ram, e_1, e_2, e_3 the masses of fresh concrete subjected to the ramming action of the ram, e the body of the moulded pile, b_2 the stones encrusted in this body so as to form anchorage projections in the ground.

The use of the process described is obviously not limited to the case of soft or water bearing ground.

The said method is also applicable to the construction of piles in any kind of ground even ground which is only slightly compressible.

It is to be particularly noted that the salient feature of the present invention is the provision in the lower end of the form, when the latter is in a driving position, of a plug which, under the repeated actions of the ram, is so compressed in the lower end of the hollow form that the continued driving actions of the ram acting on this plug alone will force the form and plug into the ground. It will, of course, be appreciated that to some extent at least the stones forming the lower portion of the plug act in a way as providing a driving point for the form, but the fact remains that the frictional grip between the plug and the form is sufficient to cause the driving action on the plug to force the form and plug into the ground without a material separation of the plug and form.

Of course, as stated, under the repeated blows of the ram, the plug may to some extent be carried beyond the free end of the form, but this tends merely to permit the stones so projecting to be forced laterally as the form descends without forcing the plug as such out of the lower end of the form. When the form has reached the desired depth it is, as explained, held against further downward movement and the following repeated blows of the ram on the plug serve to force the plug to a very considerable degree out of the end of the form. It is understood that the plug is not driven entirely out of the form until following the addition of a subsequent mass of cement, but it is to be noted that in the operation where the plug is acted on after the form is held against further downward movement, the greater resistance to the movement of the plug is in the downward direction, for naturally the ground is more compact directly beneath the plug than at the sides of the plug. Therefore, the repeated blows on the plug tend to cause that portion of the plug which is forced beyond the end of the form to spread laterally, possibly to a greater extent than downwardly. The result is that the base of the pile which, of course, is provided by the plug at least in part, is of more or less mushroom type, that is, spread laterally to a diameter materially exceeding that of the form.

Of course, if the particular work in hand requires a materially enlarged base, the subsequent batches of cement added to the form may in effect be forced into the plug to cause a further spreading of the base. After the base has been constructed to the desired mass or area, the subsequently introduced batches of cement are utilized to build the concrete pile above the base. As explained above, each successive batch of cement is subjected to the action of the ram to force the particular batch beyond the end of the form, the latter being raised for proportional distances at each successive operation. Under these circumstances, each successive batch of concrete is to some extent deflected laterally under the action of the ram and in that portion of the batch which is beyond the end of the form. Thus each batch of cement tends to produce a diametric enlargement of the normal diameter of the pile as the building up of the pile progresses. Furthermore, as each successive batch of concrete is subjected to a similar ramming action, it will be appreciated that

the lateral spread of each successive batch toward the upper end of the pile is somewhat greater than that of the preceding batch, for as the building up of the pile progresses, the natural resistance of the earth decreases, for the nearer the surface of the earth the less the compactness of the soil. Hence, under similar blows each successive batch spreads slightly more than the preceding batch, with the result that the pile when finally constructed presents a radially enlarged base and a pile length above that base which is upwardly diverging with successive areas of well defined, laterally enlarged areas, all of which tend to a more effective securing of the pile in the ground in a rigid fixed relation.

The stones forming part of the plug which have been gradually dislodged during the driving action of the plug and form and which provide more or less of a wall surrounding the form will, under the spreading action of the successive batches of concrete referred to, be naturally embedded in this concrete and, of course, in the immediately adjacent ground. These stones, forming as they do a large number of projections beyond the actual concrete surface of the pile, tend in no small degree to increase the stability and immovability of the pile.

The term "concrete" as used herein and in the claims is intended to designate any conventional material making up a dry, unset mass which, after utilization as a driving plug, may subsequently serve as the material for the base of the pile to be molded.

What I claim is:

1. In a method of molding concrete piles in the ground, those steps involving providing a hollow form with a terminal, dry, unset concrete plug, and driving the form to the required depth into the ground by driving action directly on the plug.

2. In a method of molding concrete piles in the ground, those steps involving providing a hollow form with a mass of dry, unset concrete at one end, subjecting the mass to a driving action tending to force the mass into frictional binding engagement with the wall of the form, and thereafter driving the form into the ground by a driving action on the concrete mass alone.

3. In a method of forming concrete piles in the ground, those steps involving providing a hollow form with a terminal, dry, unset concrete plug, driving the form to the required depth into the ground by driving action directly on said plug, holding the form against further movement under the driving action, and continuing the driving action to force the plug from the end of the form to serve as a base for the concrete pile.

4. In a method of molding concrete piles in the ground, those steps consisting in providing a hollow form and a terminal, dry, unset concrete plug including a mass of stones, and driving the form into the ground by repeated successive blows on the plug, the stones being gradually dislodged under the repeated blows for bearing contact with the form during movement of the latter under said blows.

5. An improved method for driving forms for the construction of concrete piles molded in the ground consisting in providing a hollow form, inserting a plug of dry, unset concrete in the end of the form, compressing the plug by an element having a rounded head to insure a fluid-tight connection between the plug and form and a frictional engagement to permit the driving action of said driving element on the plug alone to force the plug and form into the ground.

6. In a method of molding concrete or like piles in the ground, those steps involving providing a hollow form with a terminal plug of dry, unset material capable of use as a base for the pile, and driving the form to the required depth into the ground by driving action directly on the plug.

In witness whereof I affix my signature.

EDGARD FRANKIGNOUL.