May 3, 1932. H. R. SMITH 1,856,517

METHOD OF FORMING COMPOSITE PILES

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FIG. 1.

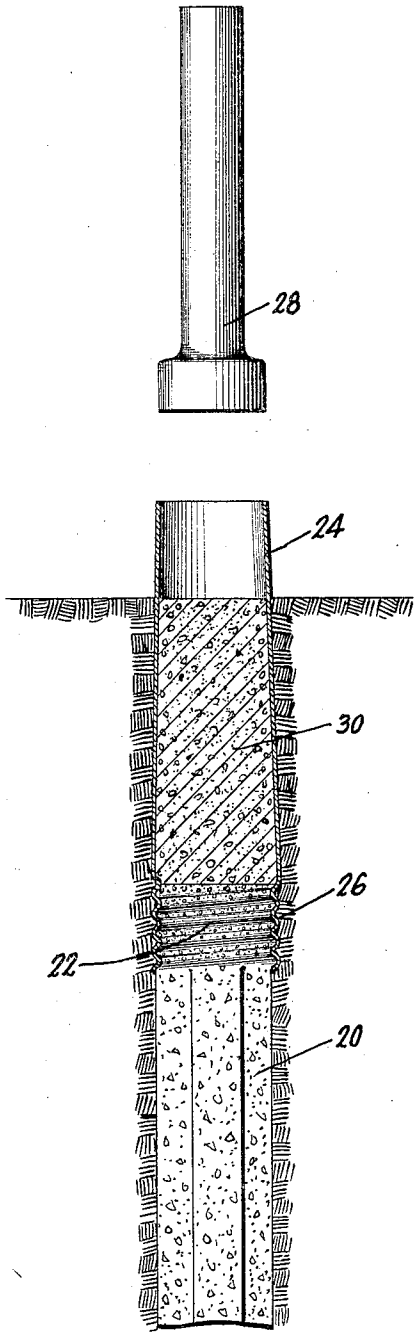

FIG. 2.

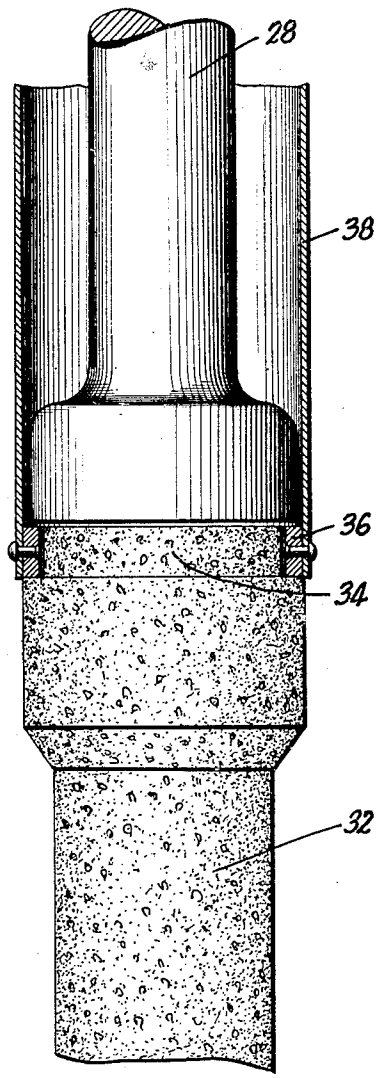

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FIG. 6.

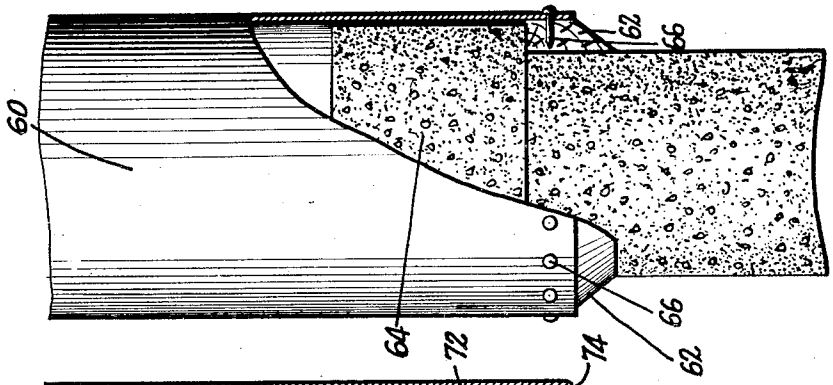

FIG. 5.

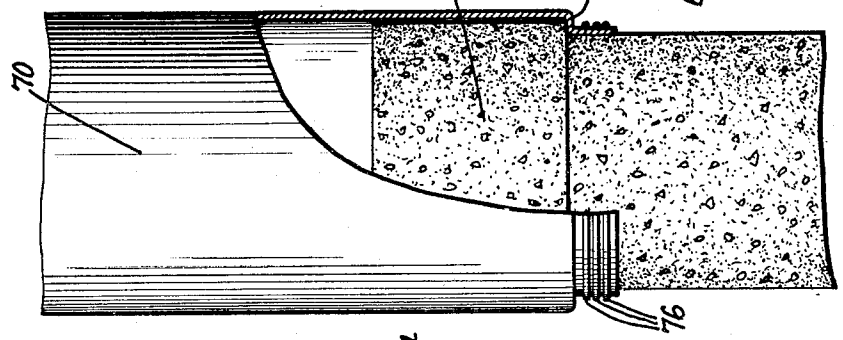

FIG. 4.

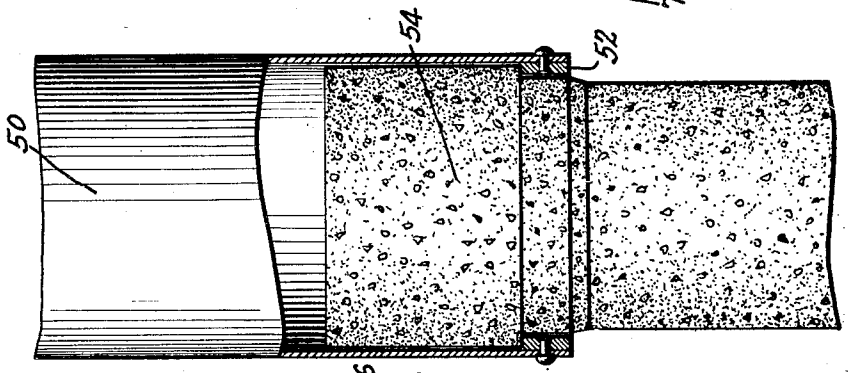

FIG. 3.

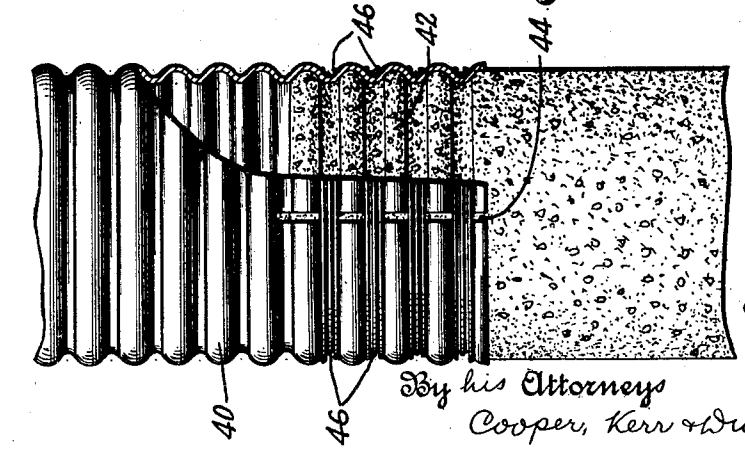

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FIG. 9.

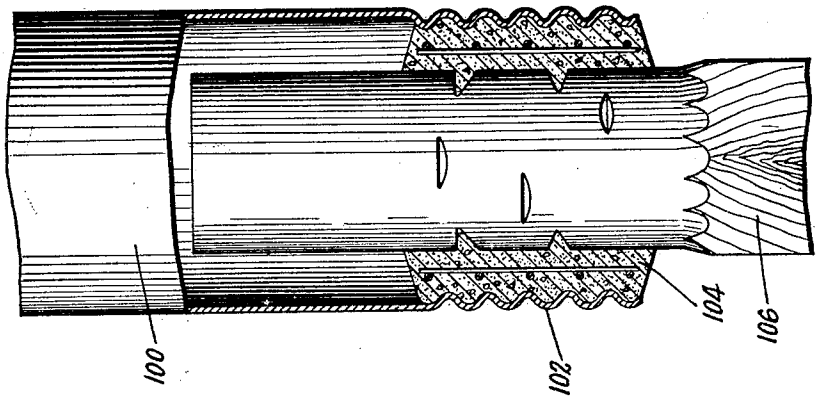


FIG. 8.

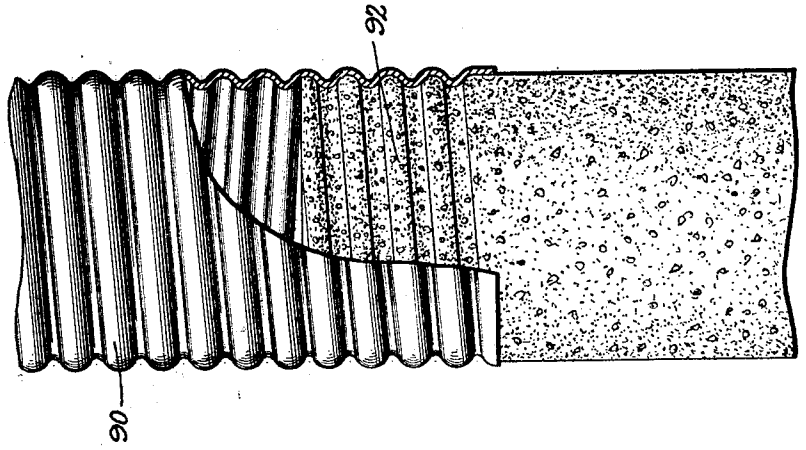
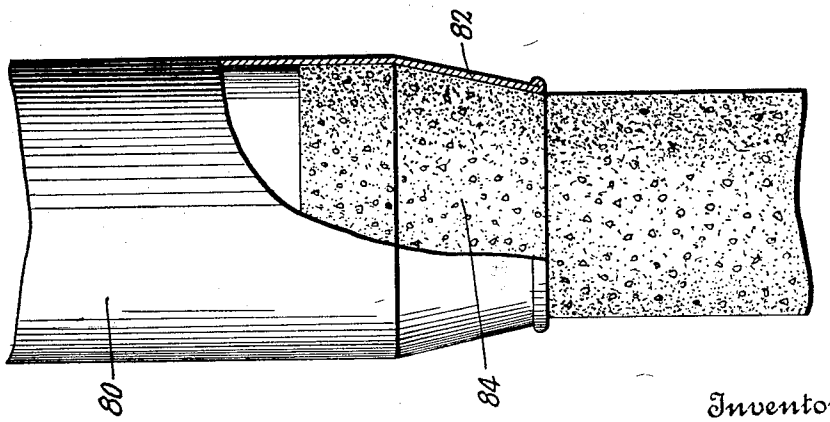


FIG. 7.



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UNITED STATES PATENT OFFICE

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METHOD OF FORMING COMPOSITE PILES

Application filed October 16, 1928. Serial No. 312,753.

This invention pertains to composite piles formed by first driving a lower pile section below ground level and then completing the pile by forming on top of the lower section an upper section of concrete in order to bring the top of the finished pile to the desired height.

One of the greatest problems of the pile driving industry arises from the fact that it is impossible to know just how long each pile should be before driving it.

If, after a pile has been driven, it is found to be too long, the top of the pile must be cut off. This is an easy operation when the pile is of wood but is a difficult and very expensive operation when the pile is composed of reinforced concrete.

To avoid the great waste of material and labor incident to the cutting off and throwing away of the tops of concrete piles, the practice has been developed of first driving a pile which is known to be too short, and then piecing it out by forming on the upper end thereof a concrete upper section cast in situ and with its top at the proper level. Such a structure, when finished, is known as a composite pile. The present invention has to do with the method of forming the upper section of a pile of that kind.

Under some conditions and soils it is feasible to simply drive the lower section to desired depth with its upper end below ground level, and then fill with concrete the hole in the ground above the lower section, the surrounding earth acting as the wall of the mold.

Under other conditions the lower section is driven as above and the earth around its upper end is excavated to permit setting up a mold in which the upper concrete pile section is formed.

The usual practice, however, is to first drive the lower section until its upper end approaches ground level, then place a steel or concrete shell on the head of that section, then drive the pile and shell until the pile reaches the proper depth, then fill the shell with concrete to the desired level, and finally to cut off the pieces of empty shell projecting above that level.

In the above practice, after the shell is placed on the lower pile section, the subsequent driving of the pile is usually done by means of a follower lowered through the shell to act on the head of the pile section, the driving effect of the hammer acting through the follower on the upper end of the pile and also on the wall or the upper end of the shell. The apparatus is so arranged that each blow of the hammer is applied to both the pile and the shell with the result that the shell is pushed into the ground along with the pile and is ready to serve as a mold for concrete as soon as the follower is withdrawn.

Another known method is to drive the lower pile section to proper depth within a casing, then attach an upwardly projecting shell to the top of the lower pile, then fill the shell with concrete to the proper level, and then withdraw the casing.

All the above methods are objectionable on account of cost. If the shell be driven by blows on its upper end, the shell may be a plain cylinder, which is an economical shape, but in order to provide sufficient rigidity it must be of excessive thickness, and therefore expensive.

If the shell be driven by blows imparted to its wall, the shell must be tapered outwardly toward the top, or must be corrugated or otherwise shaped to engage the follower. Both these expedients use considerable excess metal as compared to the plain cylindrical shell.

In the above mentioned scheme of forming the pile within a casing, a plain shell may be used, but the method is objectionable on account of high cost of labor and overhead.

All of the above objections are overcome by the present invention, which discloses the method of drawing the shell into the ground by tension applied at the lower end of the shell. This method permits the use of a plain cylindrical or inwardly tapered shell of very thin material, consequently the method has, under certain conditions, considerably cut the cost of forming composite piles.

In the drawings, which show what I now consider to be the preferred form of the invention:

Fig. 1 shows a completed pile before the upper end of the shell has been removed, and also shows the follower which was used to drive the lower pile section after the shell was attached thereto.

Fig. 2 shows a method of applying tension to the shell without attaching the shell to the lower pile section.

Figs. 3 to 9, inclusive, show various methods of attaching shells to the lower pile sections.

Fig. 1 shows a composite pile formed by the method herein disclosed. The lower precast section 20 was provided with a screw threaded upper end 22 and the lower end of shell 24 was threaded as at 26 to correspond. The lower section was driven in the ordinary manner until the threaded head was near ground level. Then the shell was attached to the pile section by screwing the threaded portion onto pile head 22. Follower 28 was then lowered through the shell to rest on the top of the precast pile section and the driving operation was resumed. As the pile was forced into the ground, the shell, being fast to the pile, was pulled down by tension to the position shown in the drawings. Then the follower was removed and the shell was filled with concrete 30 to ground level. The job will be complete when the empty upper end of shell 24 is cut off by an axe or other common tool. For clarity of illustration the shells are shown in the drawings as having considerable thickness, but in reality they are very thin. Usually they are of metal but may be of paper, fiber, or other suitable sheet material. This is possible because the shell is pulled into the ground by tension applied at its lower end, instead of being pushed down from above as in previous practice.

While the shell is being drawn into the ground by the pile, the principal resistance to be overcome by the shell is the skin friction of the earth on the shell. This resistance may be reduced if desired by forming the upper portion of shell 24 in conical form as indicated in Fig. 1.

Piles are usually driven by blows of a hammer. The pile comes to rest between blows, therefore the inertia of the driven mass has considerable bearing on the ease of driving. In this particular the present method has an important advantage over previous practice on account of the light weight of the thin shell as compared with the thick shells heretofore used.

In all figures of the drawings except Fig. 2, the shell is drawn into the ground by virtue of its attachment to the head of the lower pile section. In Fig. 2 the shell is caused to follow the pile into the ground by tension applied to its lower end, but without fastening the shell to the pile. The lower pile section 32 is provided at its uper end with a tenon-like portion 34. Encircling tenon 34 is a steel ring 36 to which is riveted the lower end of cylindrical steel shell 38. The bottom surface of follower 28 extends over tenon 34 and ring 36, therefore a part of each blow on the follower is imparted to the ring, with the result that the shell is drawn into the earth as effectively as if the shell were attached to the pile itself.

Figs. 3 to 9 inclusive show various schemes for fastening the shell to the pile. In Fig. 3 the shell 40 is corrugated with plain circumferential corrugations, not screw threaded. The head 42 of the lower pile section is corrugated to correspond to the shell. To apply the shell to the pile the shell is slit as at 44, the slit end is forced over pile head 42 and then held in place by wires 46 wrapped around the shell in the corrugations thereof.

Fig. 4 illustrates an arrangement in which the lower end of the shell 50 is provided with an internal ring 52, just as in Fig. 2 ring 38 has a ring 36. In Fig. 4, however, the pile head 54 is enlarged and ring 52 is underneath the head so that ring and shell are drawn into the earth with the pile. When this scheme is used the shell and ring are slipped onto the pile from the lower end before driving is begun.

Fig. 6 is similar to Fig. 4 except that shell 60 is provided with a wooden ring 62 instead of a metal ring 52. The wooden ring may readily be formed in sections and simply nailed to the shell; therefore it may be applied after the lower pile section is partly driven. Ring 64 is placed under pile head 64 and shell 60 is attached thereto by nails 66.

In Fig. 5 the lower end of shell 70 is slipped down past enlarged pile head 72, crimped as at 74 underneath the rim of head 72 and then bound with wires 76. The metal of the shell is so thin that the crimping may readily be done with a hammer.

Fig. 7 shows a scheme in which shell 80 is provided at its lower end with a conical portion 82 of reduced diameter which surrounds a corresponding conical head 84 on the pile. The shell is slipped over the bottom end of the pile section before driving begins.

Under certain conditions the pressure of the ground through which the shell is drawn is sufficient to collapse a plain shell. To meet such circumstances a corrugated shell such as 90 (Fig. 8) may be used to advantage. This shell is screw threaded throughout its length and the lower end is screwed onto the threaded head 92 of the lower pile section just as in Fig. 1. The lower end of shell 24 is screwed to pile head 22. The corrugated shell in Fig. 3 is also suitable for use under these conditions.

In Fig. 9 the plain shell 100 is provided with a lower screw threaded portion 102 which is screwed onto a reinforced concrete collar 104 attached near the upper end of wood pile 106, as is fully set forth in the copending applica-

tion of Elihu Watt, Serial No. 292,838, filed July 14, 1928.

The shells illustrated and described above are all of circular cross section but it will be understood that they may be of square, rectangular, or any other desired shape.

It is to be understood that the invention is not limited to the construction herein specifically illustrated and described but may be embodied in other forms without departure from its spirit as defined by the appended claims.

I claim—

1. A method of forming a composite pile which comprises driving the lower section until its upper end approaches ground level, attaching an upwardly extending shell to said upper end, inserting a follower through said shell into contact with said upper end, driving said lower section below ground level by means of said follower, whereby said shell is drawn into the ground by virtue of its attachment to said lower section, and filling said shell with concrete to form the upper pile section.

2. The method of forming a composite pile which comprises driving a pile section below surface level and pulling downwardly with said pile section, a shell by force applied solely to the pile section.

In testimony whereof I hereto affix my signature.

HERMAN R. SMITH.