

Jan. 3, 1928.

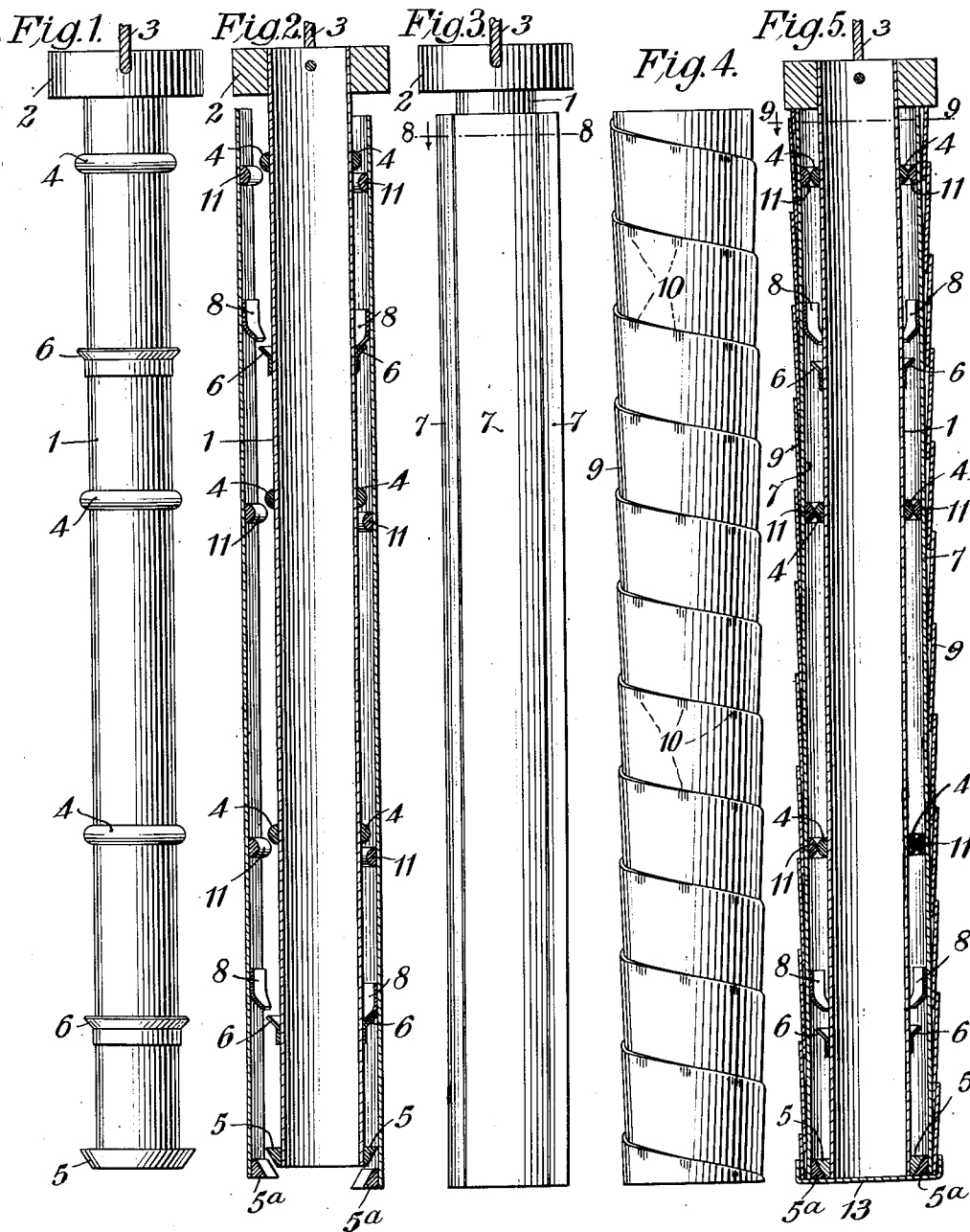
J. B. GOLDSBOROUGH

1,654,644

CONSTRUCTING PILES

Filed July 28, 1923

2 Sheets-Sheet 1



INVENTOR.
John B. Goldsborough
BY *Moskley and Gill*,
ATTORNEYS.

Jan. 3, 1928.

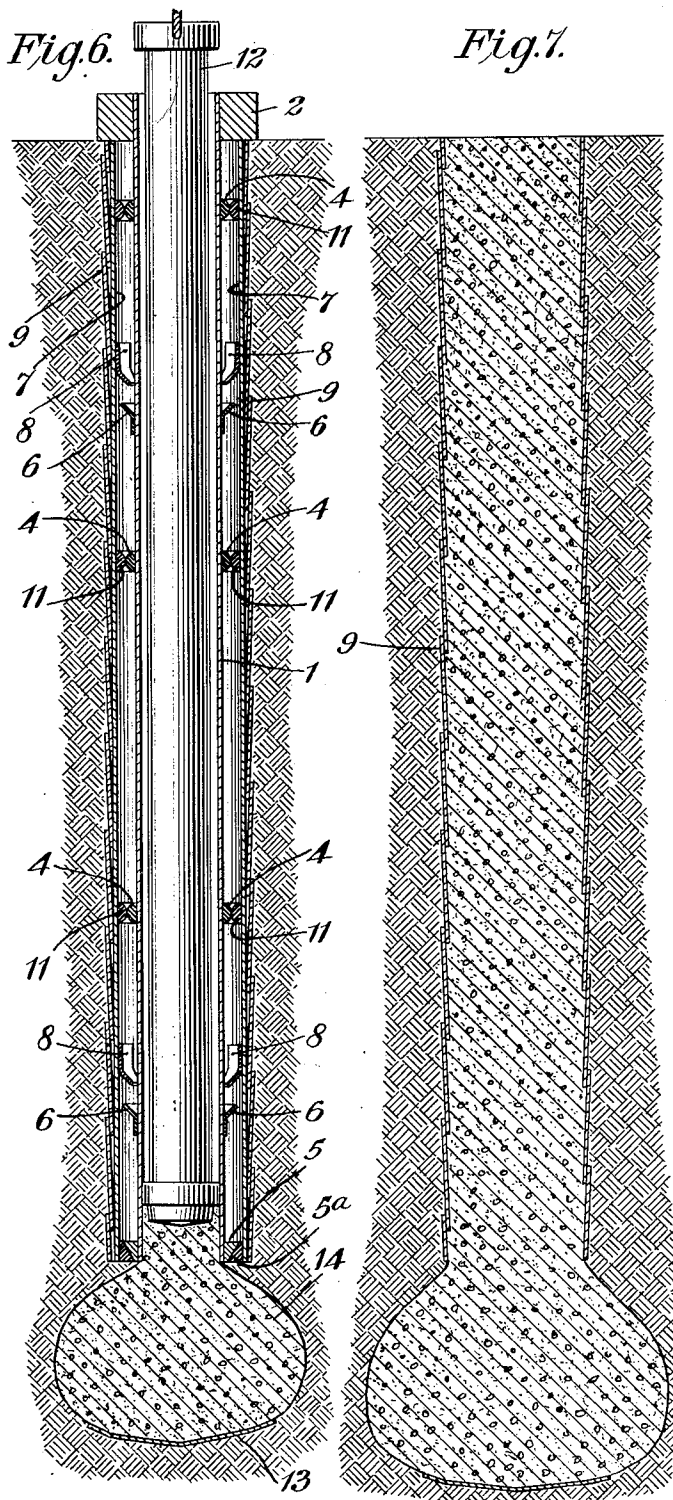
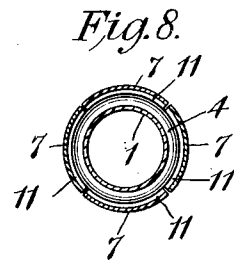
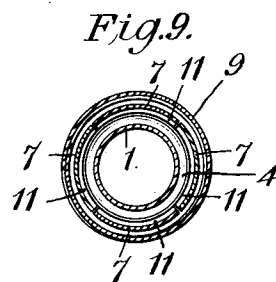
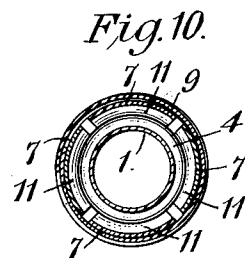
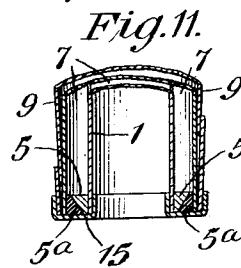
J. B. GOLDSBOROUGH

CONSTRUCTING FILES

Filed July 28, 1923

1,654,644

2 Sheets-Sheet 2



INVENTOR.
John B. Goldsborough
BY *Monteay and Gill.*
ATTORNEYS.

Patented Jan. 3, 1928.

1,654,644

UNITED STATES PATENT OFFICE.

JOHN B. GOLDSBOROUGH, OF CROTON ON HUDSON, NEW YORK.

CONSTRUCTING PILES.

Application filed July 28, 1923. Serial No. 654,315.

This invention relates to the construction of foundation piles, particularly of the type in which shells of thin metal are sunk into the ground and then filled with suitable foundation material to form permanent structures.

For reasons of economy it is an advantage to use shells constructed of thin metal, which are driven into the ground by means of devices which may be expanded tightly within the shells during the driving operation and thereafter collapsed to permit them to be removed, as the devices are too expensive to be left in the ground with the shells.

Types of piles at present in use in which thin metal shells are employed depend on the friction between the shells and the surrounding earth to carry the load ultimately to be placed upon the piles. In order to obtain sufficient friction for this purpose it is usually necessary to drive the shells to considerable depths. It frequently happens that in order to obtain sufficient friction the shells pass through the stratum of earth which would give the best supporting effect could it be utilized for this purpose.

The effect of the best supporting stratum may be obtained by forming piles having at their lower ends extended footings or bulbs located within the stratum. In practicing this method of forming foundations it is customary to use shells of relatively thick material, which are therefore expensive, and form the bulbs by inserting successive charges of foundation material into the shell and forcing them into the soil by a rammer extending through the shell and operated by a hammer or other suitable apparatus.

In the case of a shell formed of thin metal the operation of forming a bulb at its bottom cannot be satisfactorily performed on account of the shape of the shell, which is usually tapered, and also on account of the tendency of such a shell to be ruptured as the material is expelled therefrom to form the bulb.

Such expansible driving devices as have heretofore been used for sinking thin shells have not been adapted for use in connection with the usual operation of forming a bulb at the lower end of the pile.

It is an object of this invention to provide for the formation of piles in which thin,

inexpensive shells may be used and which may be provided with extended footings or bulbs thereby obtaining sufficient carrying capacity with much less penetration by making it possible to use the best supporting stratum of the soil.

It is a further object of the invention to provide an expansible and collapsible rammer which may be conveniently inserted in and removed from the thin shell and which may be driven by a heavy, power hammer without injury and with no danger that its coating parts may become so firmly united under the effect of the hammer that they cannot be released. The rammer is also so constructed that while in place in the shell after the latter has been sunk into the ground, a bulb may be formed at the bottom of the pile in a most effective manner.

A still further object of the invention is the provision of a driving device or rammer in which the lower end may be partly or entirely closed according to the character of the soil into which the pile is being sunk.

The invention also provides a shell which may be cheaply and easily formed at the location where it is to be used by helically winding a strip of thin metal and uniting the convolutions in any suitable manner. Such metal may be readily obtained from local sources of supply and formed into shells of the desired dimensions as needed.

The above objects, as well as others which will hereinafter appear, are attained by the provision of an expansible and collapsible rammer adapted to be inserted in a shell and comprising a hollow core provided at intervals with wedging members adapted to cooperate with similar members on arcuate sections which surround the core and may be forced into engagement with the inner face of the shell by causing the wedging members to become effective by relative longitudinal movement between the core and the sections. The outer surface of the core and the inner surface of each section are provided with coating members by which the sections may be held upon the core while the device is being placed in the shell preparatory to being expanded within the latter or while being withdrawn from the shell after the latter has been sunk.

During the sinking operation the core may be filled with an auxiliary rammer extending

to its lower end to prevent the entrance of soil into the core or the entire lower end of the structure may be closed by a cap for the same purpose or both of these arrangements may be used, in case the soil is of such a character that it is necessary or desirable to employ a structure entirely closed at its lower end. In case the soil is compact and difficult to displace or the piles have to be driven in close proximity, the core may be left open at its lower end and the space between it and the sections may be closed by an annular member, the core being subsequently cleaned out by compressed air or any of the usual methods.

By using a hollow core with relatively thick walls for the central member of the collapsible rammer a rigid conduit is obtained through which the usual operations of forming a bulb at the lower end of the pile may be performed by expelling successive charges of foundation material from the lower end of the conduit by means of an auxiliary rammer in the core. Since the core of the driving device is of lesser diameter than the pile shell which is driven by the device, an increased pressure per unit of area may be obtained upon the material expelled from the core than could be obtained upon a column of material of the diameter of the shell, by the same force exerted by the hammer of the pile driver used for performing the sinking and bulb forming operations.

The particular nature of the invention as well as other objects and advantages thereof will appear more clearly from a description of certain preferred embodiments thereof as shown in the accompanying drawings in which

Fig. 1 is a side elevation of the central core of the collapsible rammer;

Fig. 2 is a vertical sectional view, showing one of the displaceable sections before it is engaged with the central core, and with another similar section engaged therewith;

Fig. 3 is a side elevation, illustrating the collapsible rammer with all of its sections supported by the central core;

Fig. 4 is a side elevation of the helically formed pile shell;

Fig. 5 is a vertical section, showing the collapsible rammer fully inserted in the helical pile shell and expanded therein, the entire structure being in condition for entry into the ground;

Fig. 6 is a similar view, illustrating the assembly of Fig. 5 sunken into the ground, and an auxiliary rammer being shown in the process of forming a bulb footing for the pile;

Fig. 7 is a vertical section through the completed pile in the ground;

Fig. 8 is a horizontal section, taken on the line 8—8, of Fig. 3;

Fig. 9 is a similar view, taken on the line 9—9 of Fig. 5, but represents the rammer in its collapsed condition;

Fig. 10 is a view similar to Fig. 9, but shows the collapsible rammer expanded; and

Fig. 11 is a vertical section of the lower part of the collapsible rammer within the helical pile shell, and particularly shows the application of a different type of bottom cap.

Referring to the drawings, 1 represents the main body portion of the unyielding central member or core of a collapsible rammer, which may conveniently be in the nature of a tube of suitable diameter and length. At its upper end, the tube 1 has a head 2 unified therewith, a cable 3 being attached to the head, whereby the core, as well as the collapsible rammer in its entirety, may be moved in accordance with the requirements of the pile-constructing operations. Encircling the tube at longitudinally spaced locations are rings or annuli 4 and 5, the latter ring being at the bottom margin of the tube. These are rings that may be descriptively termed the inner or core cam rings, and will be again referred to at a more advantageous place in the specification.

Also girdling the core tube 1, intermediate certain of the cam rings 4, and 4 and 5, are socket rings 6. Inspecting Fig. 2, sections 7 of the expansible tube of the collapsible rammer are to be noted, the one shown at the left being in a position which may be regarded as one in which the section is about to be either brought into or taken out of operative relation with the central core. The sections 7 are provided with attachment clips 8 having inwardly projecting tongues, and at the left in Fig. 2 the tongues are somewhat removed from the socket rings 6, but at the right the section 7 has the tongues of its clips 8 entered into the socket rings 6, this section 7 thereby being hung upon the central core 1.

When all of the sections 7 are thus hung upon the central core 1, the external appearance of the collapsible rammer corresponds to what is shown in Fig. 3, and Fig. 8 shows that the sum of the sections 7 co-act to produce a plurally and longitudinally split tube, substantially concentric with the tube 1 of the central core. The collapsible rammer, in the collapsed condition illustrated in Fig. 3, is ready to be carried by the cable 3 to a state of suspension over the top of the helical hollow pile shell 9, into which it is subsequently lowered. The cable 3 ordinarily will be part of usual and well-known pile-driving apparatus.

The pile shell 9 is made of thin metal of any appropriate width, helically wound at a suitable pitch, the overlapping marginal borders of adjoining convolutions being spot welded, as at 10, though other means may be employed to preserve the relation of the

wound sheet metal. The horizontal section shown in Fig. 9, reveals the collapsible rammer of Fig. 8 after it has been lowered within the helical pile shell 9, still in its collapsed condition.

Each of the sections 7 of the expansible tube of the collapsible rammer is provided with arcuate cam followers 11 and 5^a, and when all of the sections 7 are hung upon the central core 1 in their collapsed positions, the cam followers 11 and 5^a form plurally subdivided rings concentric with the cam rings 4 and 5, but are not in the same horizontal planes therewith until the head 2 is struck a blow, as by the hammer of the pile-driver (not shown).

By such a blow, the parts are driven into the positions shown in Fig. 5, it being seen that the socket rings 6 have moved away from and out of engagement with the tongues of the clips 8. Also the cam rings 4 and 5, through their vertical displacement are in alignment with the cam followers 11 and 5^a they are associated with, and in taking up their aligning positions have been forced outwardly, as have the sections 7, expanding the expansible tube of the collapsible rammer. The sections 7 thus become wedged tightly against the inner surface of the helical pile shell 9, a skeletonized mutually reinforcing driving structure being formed for temporary correlation, as shown in Fig. 5, a cap 13 closing the bottom of the structure 9. It will also be noted that the head 2 of the central core 1 is in as low a position as it can take, and that consequently the cam rings 4 and 5 and the cam followers 11 and 5^a are properly aligned automatically and so maintained. Additionally, the cam ring 5 and the followers 5^a automatically assume reinforcing positions at the bottom of the pile shell 9, above the cap 13 and between the central core 1 and the expanded outer tube formed by the sections 7.

An adequate succession of blows by the pile driver (not shown) on the head 2 of the collapsible rammer will result in sinking the structure of Fig. 5 into the ground, as shown in Fig. 6. In the latter view, an auxiliary rammer 12 is shown in the process of forming an extended footing or bulb 14 for the pile, the cap 13 having been forced off the shell 9. The use of the central core tube 1 as a cylinder in which the auxiliary rammer 12 may act to transmit the blows of the pile driver to the foundation material for forming the bulb assists materially in this operation inasmuch as the force of the blow delivered by the pile driver remains constant while the area of the foundation material acted upon is less than the final cross sectional area of the ultimate pile. Therefore, the impact on the foundation material is in effect at an increased poundage per unit of area.

A footing 14 of sufficient proportions having been formed by the expulsion from the tube 1 of successive charges of foundation material, the auxiliary plunger 12 may be connected to the head 2 by suitable devices and the pile driving apparatus operated to lift the structure out of the ground. As soon as the cam rings 4 and 5 have been drawn up out of engagement with their co-acting cam followers 11 and 5^a, respectively, the sections 7 will be freed and their clips 8 will soon be engaged by the rising socket rings 6. These sections will then automatically drape themselves about and on the tube 1, in the relation shown in Figs. 3 and 8, and will be carried up and out of the pile shell 9. Thereafter this shell may be filled with foundation material, such as concrete, to form the finished pile shown in Fig. 7.

In places where a bulb footing is not necessary or desired for the pile, the auxiliary plunger 12 will not be used, the collapsible rammer being withdrawn, after the shell has been sunk to the required depth. The shell will then simply be filled with foundation material. In any event, the pile will have its full cross sectional area at the bottom and thus retain its maximum load-sustaining qualities.

Other difficulties are met with in sinking piles, and it is a purpose of this invention to so characterize the method of constructing a pile that the natural hindrances encountered may be discounted. In Fig. 6, it is obvious that an appropriate type of tool may replace the auxiliary rammer 12, by means of which especially compact soil, partially disintegrated rock, or rock itself may be broken up, and thereafter excavated by any of the known methods.

In Fig. 11 the bottom of the temporarily reinforced pile shell has an annular cap 15 applied to it, instead of the cap 13 which is shown in Fig. 5. The cap 15 has a U-shaped cross section, whereby the lower ends of the pile shell 9, the expansible tube comprising the sections 7, the central core tube 1 and the cam 5 and cam followers 5^a are completely covered. This arrangement is of value where it is necessary to drive a number of piles in close proximity to each other or when the soil is compact and difficult to displace. With the arrangement shown in Fig. 11, all of the soil within the central core tube 1 is practically undisturbed by the sinking of the pile shell 9 and the parts of the collapsible rammer that are associated with it during this operation. In some cases, if this were not so, the number of piles necessary to sustain a given load within a narrowly restricted zone could not be driven at all, and either more expensive means for attaining the required support would have to be resorted to, or an undesirable change made in the plans, while in some instances

the project would be apt to be discarded as too expensive and impracticable.

After the pile shell, capped as shown in Fig. 11, has been sunk with the aid of the collapsible rammer, the core 1 may be excavated by well known means, and the rammer withdrawn unless it be desired to form a bulb at the base of the pile, which operation will be performed as above described, the shell 9 being finally filled with foundation material.

While certain preferred embodiments of the invention have been shown and described herein it will be understood that various changes may be made without departing from the principle of the invention as defined in the appended claims.

What I claim is:—

1. A collapsible rammer for insertion into a foundation pile shell comprising a central core having a passage therethrough for foundation material and having socket means at the exterior thereof, an element having sections adapted to be supported by said central core and having members to enter said socket means for supporting said sections and means to expand and contract such sectional element within the pile shell.

2. A collapsible rammer for internal combination with a pile shell comprising a hollow, cylindrical core, an expansible member formed of independent sections, means adapted to removably support said sections from said core, and means co-operative with said core and sections to expand and contract the latter.

3. The combination with a pile shell of a collapsible rammer comprising a plurality of tubular members one surrounding the other within said pile shell one of said members being expansible, means coacting with said members to actuate said expansible member, and an annular cap to close at the lower end of the pile shell the space between the latter and said tubular members.

4. The combination with a pile shell of a collapsible rammer comprising a hollow central core, independent sections forming a split tube surrounding the core, retaining devices detachably supporting said sections from said core, and means operable to detach said sections from said core and rigidly combine them and said shell and core.

5. The combination with a foundation pile shell of a collapsible rammer comprising a central core having a head for the application of force, a subdivided tube surrounding said core the subdivisions thereof being normally supported by said core for automatic interruption of such support, and means responsive to force applied to said core head to expand said subdivided tube to effect a rigid combination of said shell, tube and core.

6. The combination with a foundation pile

shell of a collapsible rammer comprising a hollow, central core having a head for the application of force, a plurality of sections forming a longitudinally subdivided tube embracing and normally supported by said core, said sections being displaceable to interrupt such support and members respectively related with said core and sections operable under the control of said head to rigidly combine said shell and collapsible rammer.

7. In combination, a collapsible rammer for internal combination with a pile shell comprising a central core, a plurality of sections arranged about said core and forming a longitudinally subdivided tube, means normally supporting said sections from said core and movable longitudinally of the latter into and out of a support-establishing position, and means operable to expand said sections and differently support the latter, said core being adapted to be withdrawn from the pile shell and to engage and withdraw said sections.

8. A driving unit for the formation of a pile cavity in the ground, said unit comprising a pile shell, a central core therein, a plurality of sections surrounding said core and forming a longitudinally divided tube, means adapted to lock the parts in rigid relation and against displacement during driving operations, and an annular cap on the bottom of said pile shell for closing the bottom of the space between the core and the sections.

9. In combination, a pile shell of thin metal, and an expansible and contractible rammer adapted to be expanded to reinforce the pile shell and having a central core with a passage for foundation material, said passage serving also as a guiding bore for a plunger for forcing the foundation material from the bottom of the core.

10. A collapsible rammer for insertion into a foundation pile shell, comprising a central member having a passage therethrough of uniform diameter to receive a rammer for forcing foundation material from the lower end of the member, an expansible member adapted to be placed around the central member and within the shell and means associated with the central member for expanding the other member within the shell whereby the shell may be driven into the ground.

11. The combination with a foundation pile shell of a collapsible rammer comprising a hollow, central core having a head for the application of force, a plurality of sections forming a longitudinally subdivided tube embracing and normally supported by said core in a self-freeing manner, means respectively related with said core and sections operable under the control of said head to rigidly combine said shell and col-

lapsible rammer, and including a beveled cam ring extending around said core at its lower end and complementary cams at the lower ends of said sections to cooperate with said ring and hold the lower ends of said sections firmly against the inner face of said shell. 15

12. The combination with a pile shell comprising a plurality of tubular members one within another within said pile shell, one

of said members being expansible, means coacting with said members to actuate said expansible members, and an annular flanged cap to cover an annular space at the bottom of said pile shell and to receive between the flanges thereof the lower edges of said shell and tubular members.

In testimony whereof I affix my signature.

JOHN B. GOLDSBOROUGH.