No. 898,013. PATENTED SEPT. 8, 1908.

F. W. SKINNER.

PILING AND METHOD OF CONSTRUCTING THE SAME.

APPLICATION FILED AUG. 21, 1905.

3 SHEETS—SHEET 1.

Fig. 1

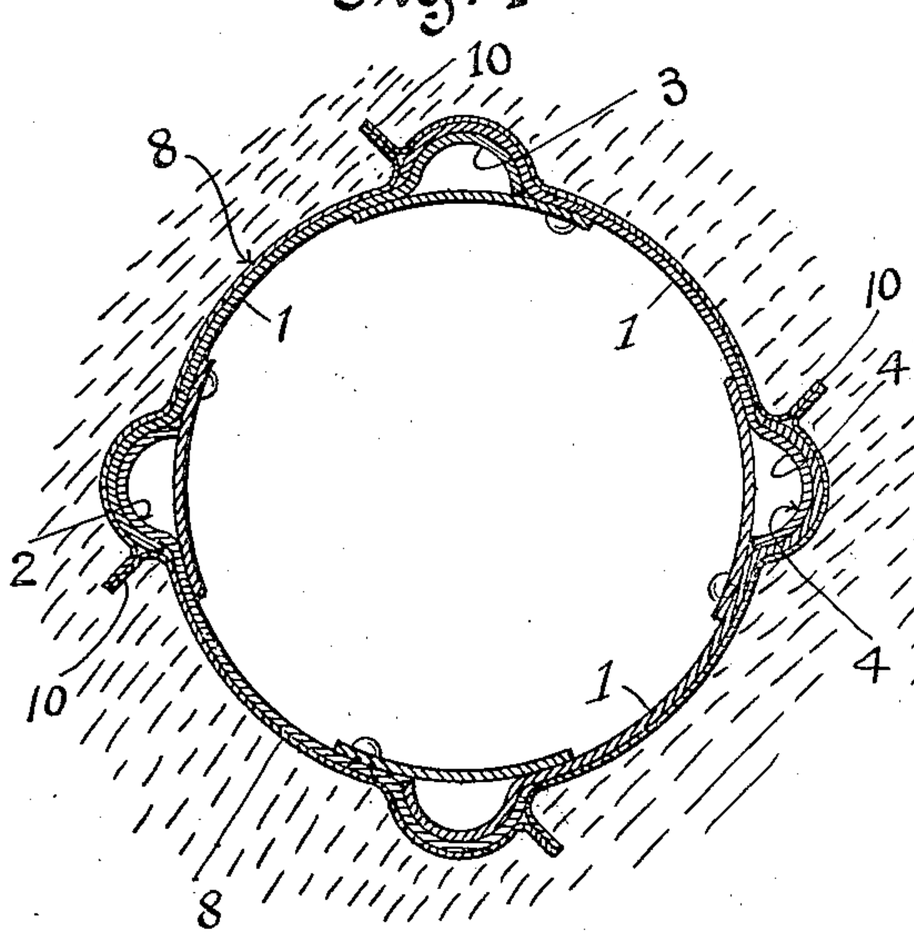


Fig. 2.

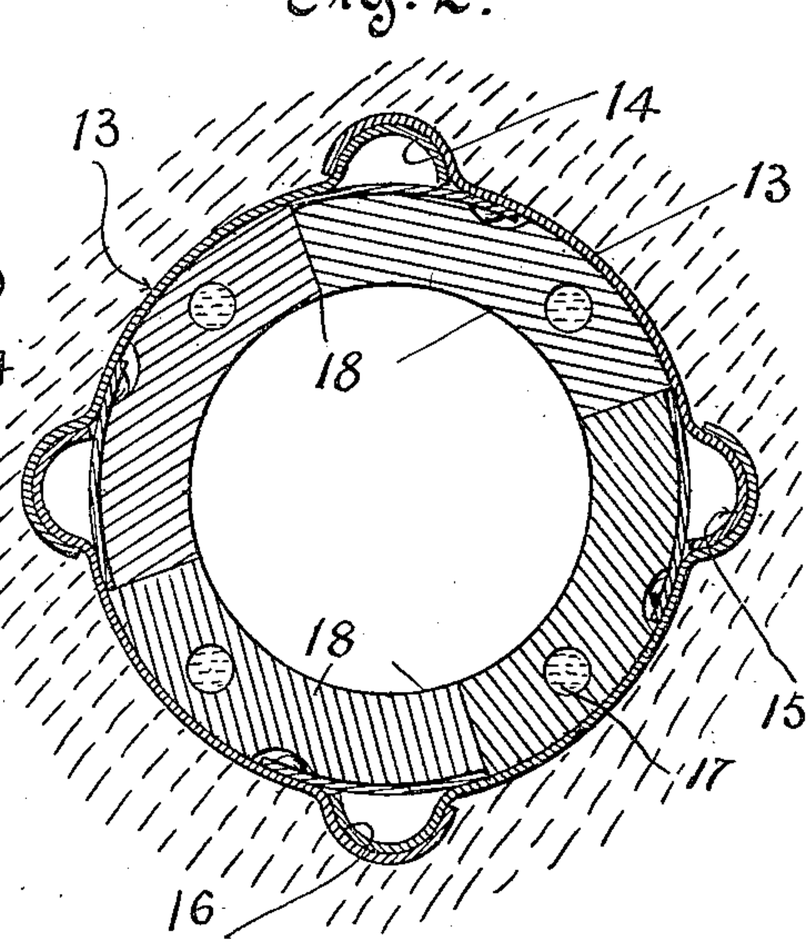


Fig. 3.

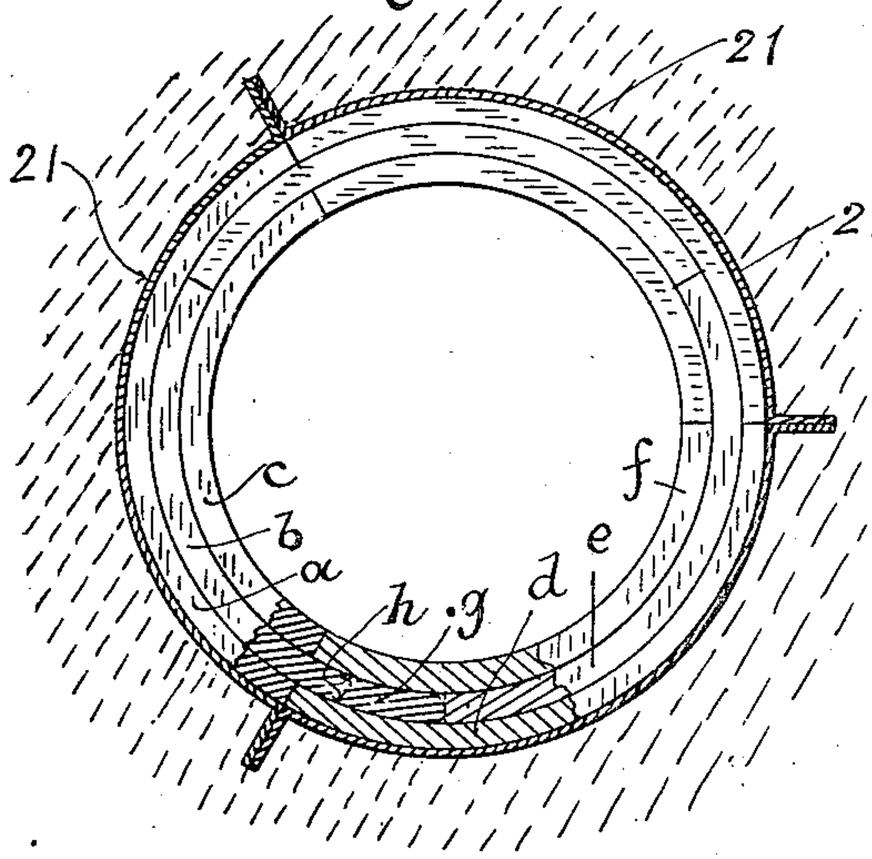
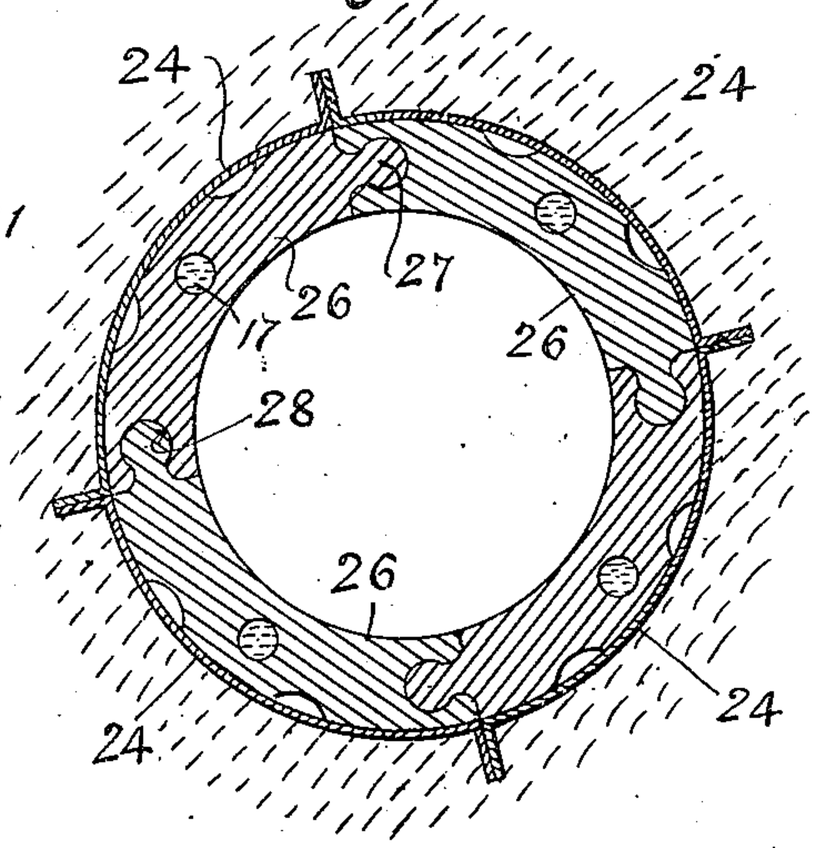


Fig. 4.



Witnesses
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3 SHEETS—SHEET 2.

Fig. 5.

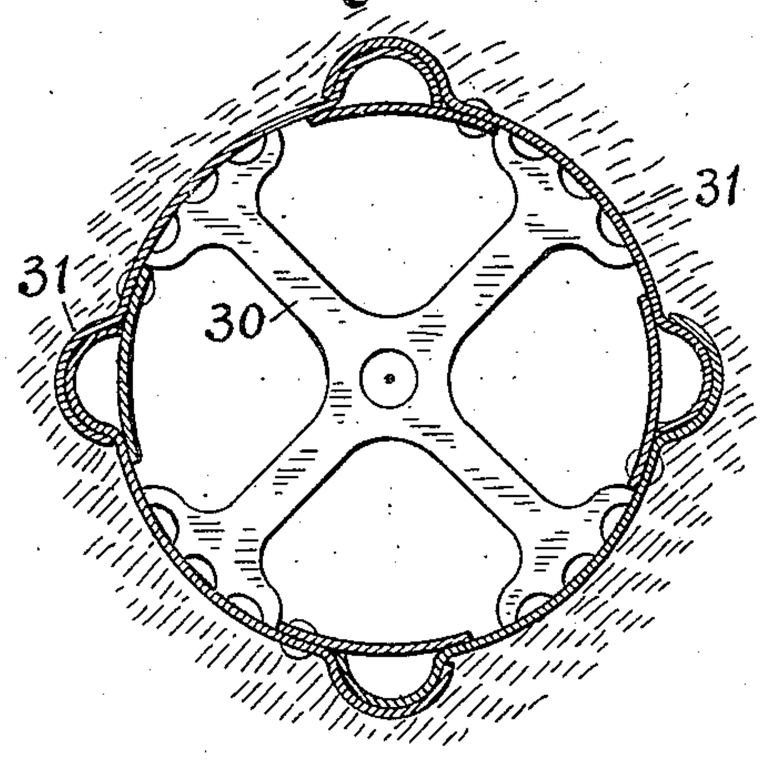


Fig. 6.

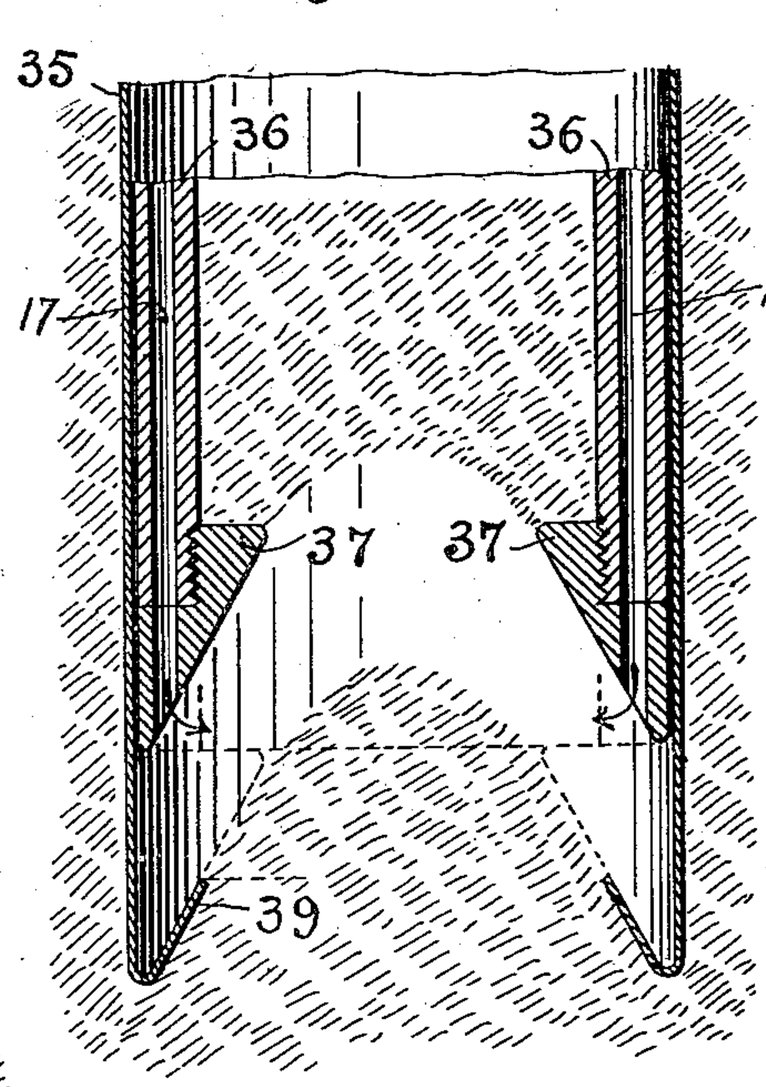


Fig. 7.

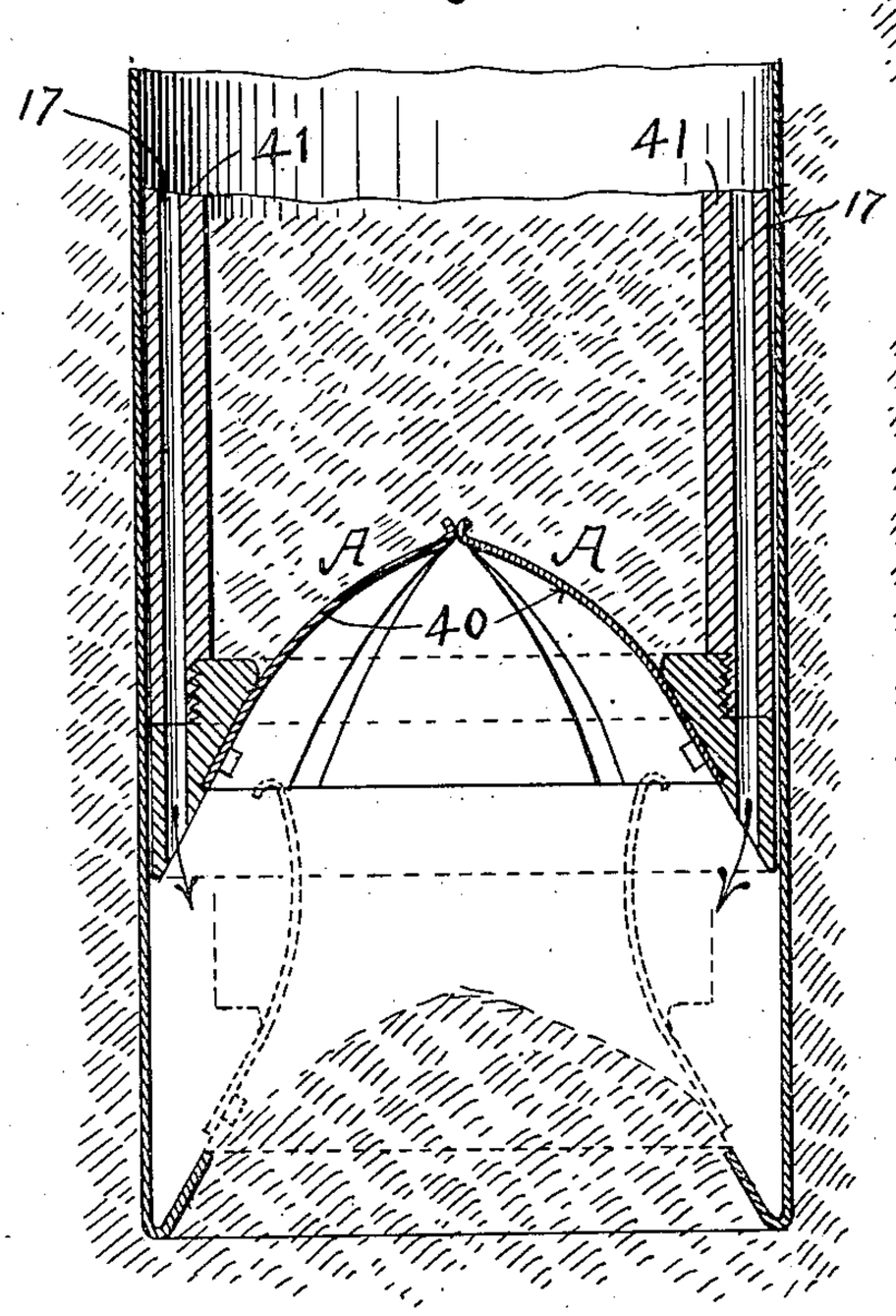
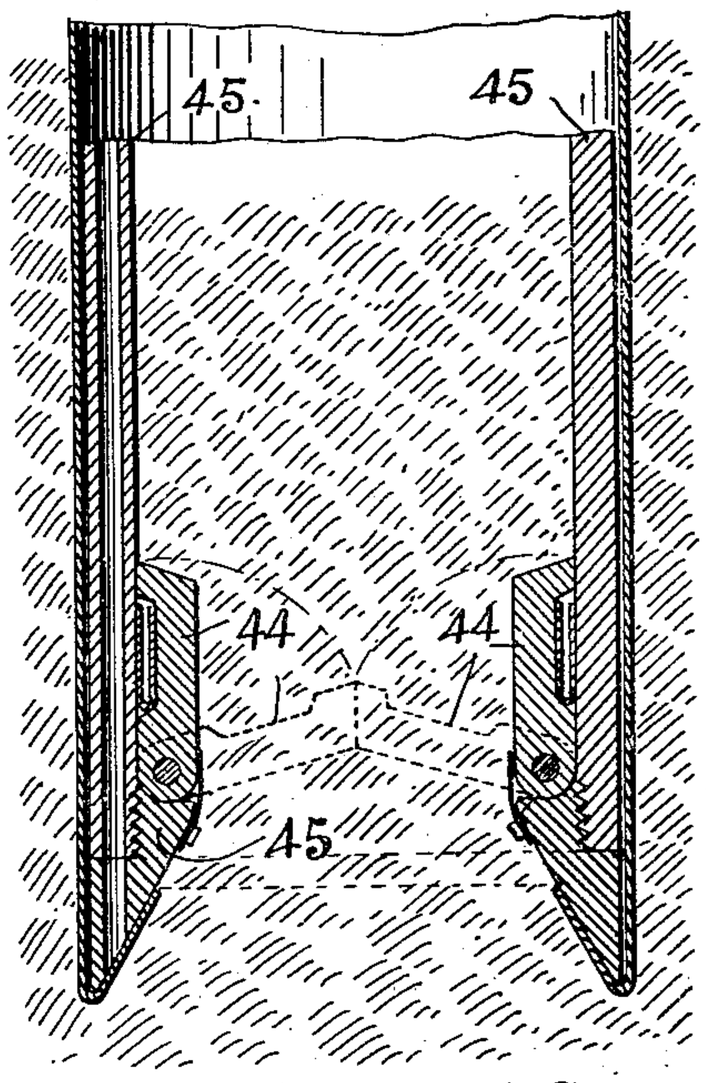


Fig. 8.



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3 SHEETS—SHEET 3.

Fig. 9.

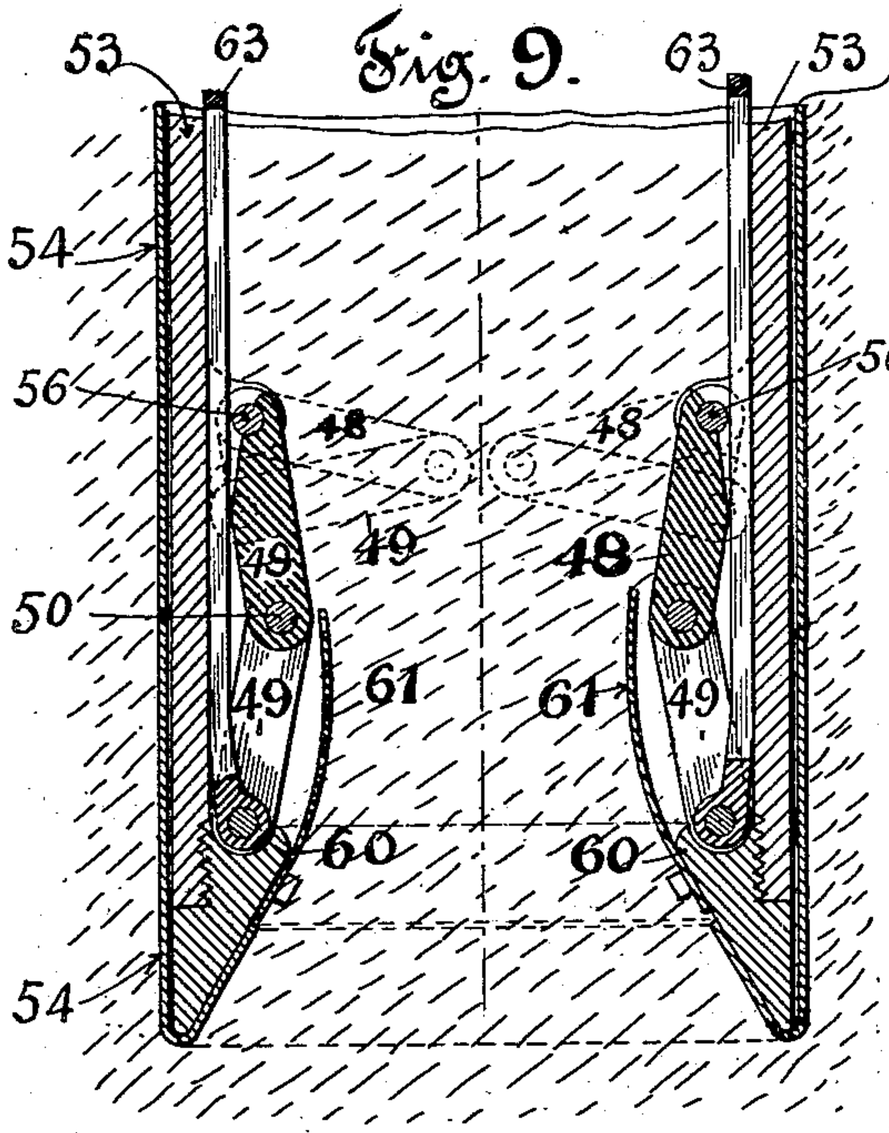


Fig. 12.

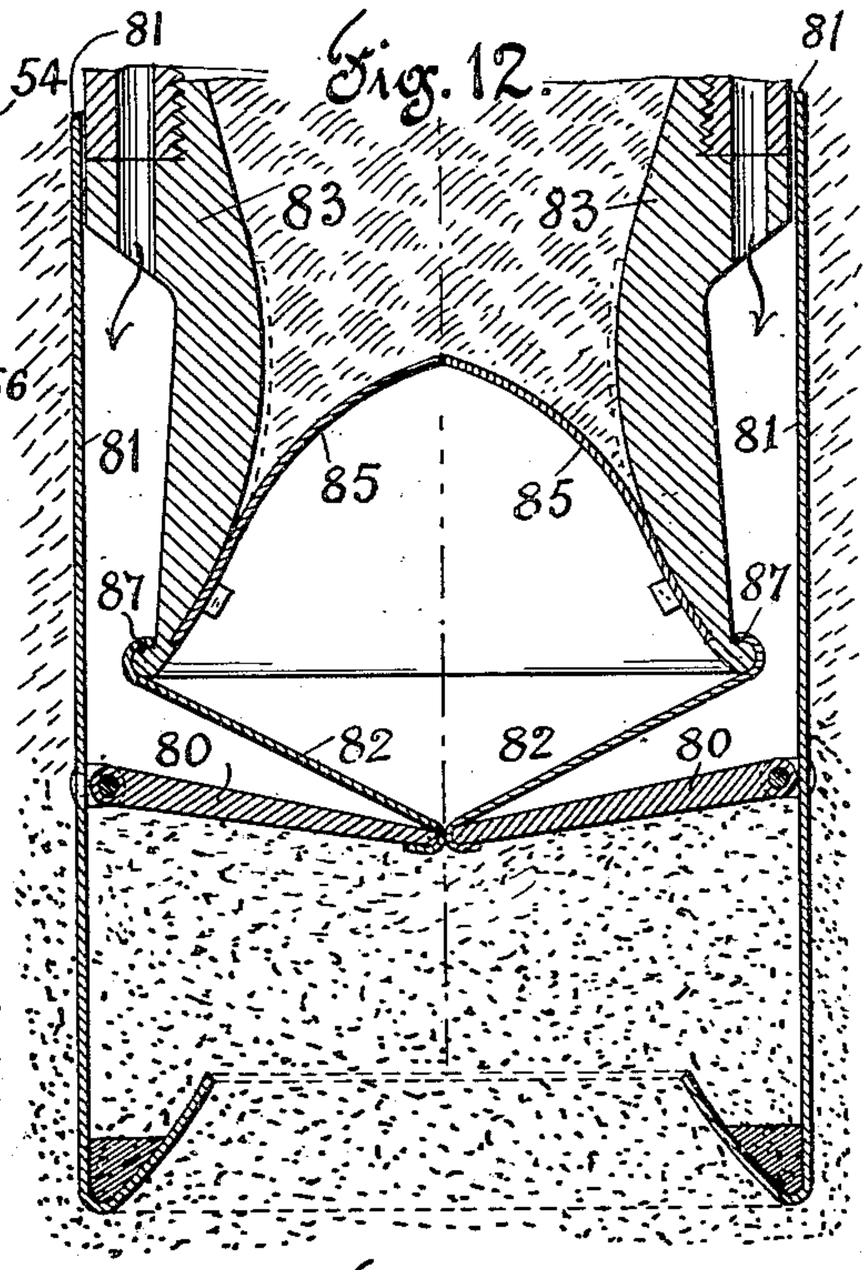


Fig. 10.

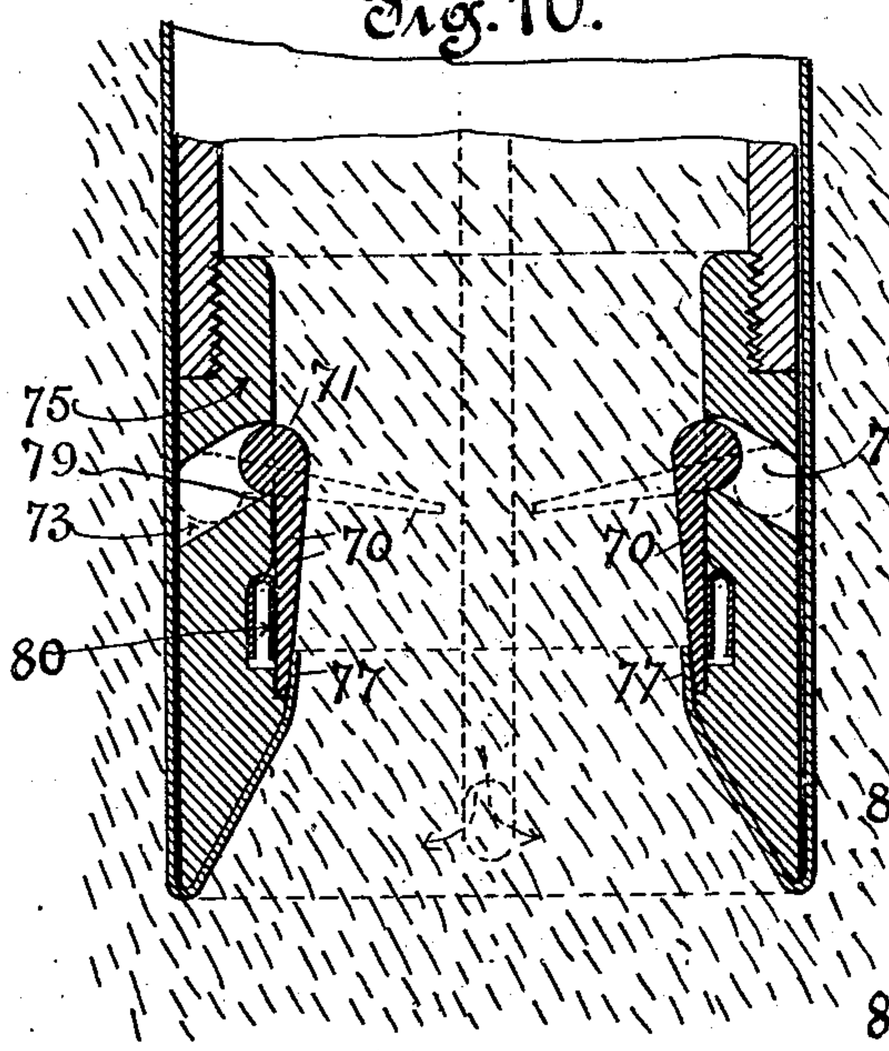
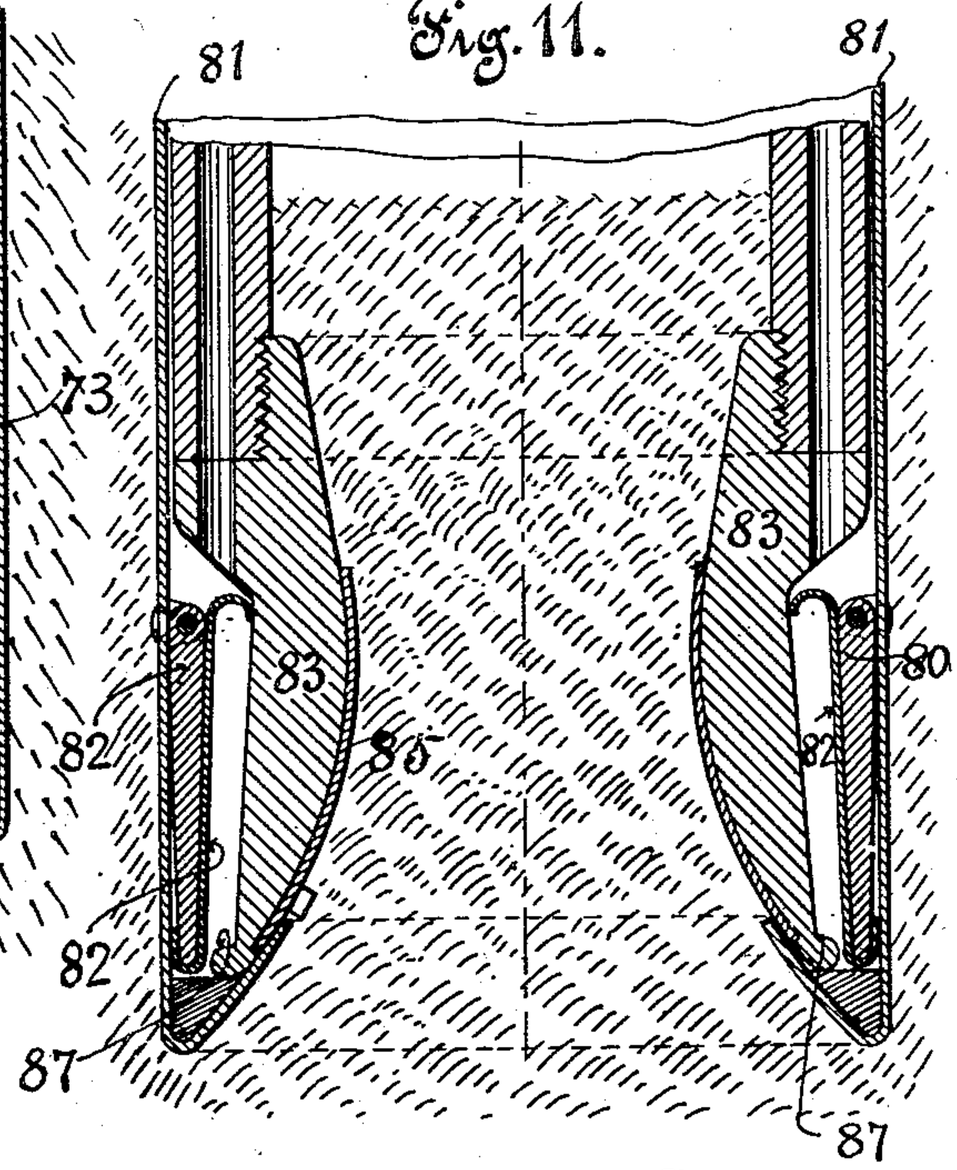


Fig. 11.



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PILING AND METHOD OF CONSTRUCTING THE SAME.

No. 898,013. Specification of Letters Patent. Patented Sept. 8, 1908.

Application filed August 21, 1905. Serial No. 275,183.

To all whom it may concern:

Be it known that I, FRANK W. SKINNER, a citizen of the United States of America, and a resident of New Brighton, in the borough of Richmond, city of New York, State of New York, have invented certain new and useful Improvements in Piling and Methods of Constructing the Same, of which the following is a specification.

This invention relates to improvements in piling and methods of constructing the same, and is particularly applicable to the case of large bearing piles.

It is designed to promote the economy, ease and rapidity and safety of driving such piles, the driving and concreting of hollow piles, and the driving of sheet piling and excavating of materials adjacent to them and the placing of concrete in required position for the finished structure.

This invention particularly relates to hollow or annular piles, and to the construction therewith of devices for removing the earth from the interior of the pile.

It also relates to the sectional construction of such piles in order to facilitate driving them, particularly when of large size, and to the combination with the sectional piles of earth removing devices, and to the adaptation of such devices to various cases, and also to devices for closing the interior of the pile after or simultaneously with the removal of the cores and earth, as may be necessary when the piles are sunk in quick-sand, and in other cases.

Heretofore sectional piling has been used only in the case of sheet piles, but I propose to use sectional piling for single separate bearing piles where on account of large size or other consideration it is easier or more convenient to drive the pile in successive sections. The complete cross section may have a circular, rectangular or any other desirable shape, and is composed of several longitudinally separated pieces either duplicates or of different forms, which are provided with tongue and groove, dovetail or other convenient sliding joints on one or more surfaces of each, so that as the sections are successively driven in contact with each other they interlock and eventually form a single unit. This enables the finished pile to be made larger than is other wise possible, it increases the strength above that of a cluster of separate piles of the same dimensions of the sections, and enables them to be driven more rapidly and with lighter machinery than would be possible for very large single piles.

When the diameter of the pile becomes very large the displacement of earth in driving is very great and is difficult for a solid pile and I provide a hollow annular or polygonal sectional pile which can be much more easily driven. A simple single-piece permanent or removable hollow pile or tube is well known in the art of pile driving, but I introduce a new feature in using it without a closed point, as a driving piece or core to drive a thinner outside shell which remains in position after the center driving piece is removed. This core may be provided with a ribbed or grooved and greased outer surface to facilitate its withdrawal. When the diameter of the pile becomes still larger it is difficult to drive a large hollow cylinder at one operation with ordinary appliances, and I make both core and outer shell with sectional annular pieces or polygonal pieces. Either or both the driving pieces and the shell sections must be united by lock joints or either one may have radial butt joints and the other may have lock joints, which will preferably be my spring lock joint for units made of plates. Various other forms of joints may however be used, but the spring joints for the outer shell are preferable on account of their strength, accuracy, convenience, ease of driving economy and watertightness. It is obvious that by the use of sufficient units in the shell and center parts or driving pieces, annular or hollow piles of great diameters may be driven. Those extreme dimensions may be considered as coffer-dams, particularly when the driving bars or cores are removed and the outer shell alone is left in position. As the methods and principles are exactly the same in all cases, no distinction is here made, and this process and all its features are presented as intended for ordinary piles, for piers, and for coffer-dams. Sometimes the hollow annular or polygonal cross section of the pile or pier will require only the permanent metal section and need not be filled solid, in which case the earth core is negligible, and the operation is completed with the driving of the piles as already described.

When it is necessary I provide earth-removing devices for removing the core of earth or other material through which the

pile has penetrated. I employ earth-removing devices and several forms of such devices adapted to various piles and conditions are illustrated in the accompanying drawings and are herewith described.

The invention is manifestly capable of being embodied in numerous constructions differing in various details, and I therefore illustrate several forms in the accompanying drawings, without however intending to limit myself to only such modifications.

Referring to the said drawings, which accompany the specification to aid the description Figure 1 is a cross section of one form of sectional pile with a sectional core, or driving bar, the sections of which are united by spring joints. Fig. 2 is a cross section of another form of sectional pile with a sectional core formed with butt joints. Fig. 3 is a cross section of a sectional pile with laminated sectional core. Fig. 4 is a cross section of a sectional pile having a core with sections interlocking together with dovetails and grooves. Fig. 5 is a cross section of a sectional pile with a skeletonized core or spacer. Fig. 6 is a broken longitudinal section of a pile having a core provided with one form of earth-removing devices. Fig. 7 is a broken longitudinal section of a pile having a core provided with another form of earth removing devices. Fig. 8 is a broken longitudinal section of a pile having a core provided with pivoted earth-removing fingers. Fig. 9 is a broken longitudinal section of a pile and core provided with toggled earth lifting devices, operated by rods. Fig. 10 is a broken longitudinal section of a pile and core especially adapted for driving in hard soils. Fig. 11 is a broken longitudinal section of a pile and core provided with earth-lifting devices and means for closing the bottom of the pile, the parts being in the position assumed when the pile is driven, and Fig. 12 is a similar section of the same parts in the position assumed when the core is beginning to be drawn up.

In Fig. 1, the inner member, driving bar, or core, of the hollow pile is formed of sections 1, preferably of stiffish sheet metal united by any suitable means, as the spring lock joints, 2, 3, 4, which are preferably similar to the spring lock joints, described and claimed in my other application for Letters Patent, filed in the United States Patent Office, Aug. 3, 1905, Serial Number, 272,465. The outer shell is also made in sections 8 8, which may be connected by butt joints 10, 10, or by spring lock joints, or in any other suitable manner, and it will be understood that the bottoms of said sections 8 8 will be bent up around the said core sections 1, 1, substantially as indicated in Fig. 8, and at the top the sections 8, 8, may be bolted to the sections 1, 1, by removable bolts if desired.

In Fig. 2 the sections of the shell, or pile, 13, 13, are illustrated as connected by spring lockjoints 14, 15, 16 and the core is formed of sections 18, 18 of a thick annulus, so as, when united, to form an annular core as shown. In the figure the sections of the core are indicated as making suitable butt joints with each other, and any suitable form of easily separated joint may be used. The sections of the shell 13 may be connected with their respective sections of core 18 by the bent up lower ends of the shell sections and removable bolts, as hereinbefore mentioned.

In Fig. 3, the shell is represented as made in sections, 21, 21 united by butt joints and the core as constructed of laminated sections, the laminæ being broken away on one side to show the tongued and grooved locking devices of the core sections. It will be understood the several laminæ, as *a*, *b*, *c*, *d*, *e*, *f*, will be riveted or otherwise fastened together, and provided with tongues *g*, and grooves *h*, to connect with other sections of the cores.

In Fig. 4 the shell is in sections 24, 24, with butt joints, and the annular core is made up of sections 26, 26 united by dovetails 27 and grooves 28, and of course it will be understood that the several sections of the shells of Figs. 3 and 4 will be removably connected to their respective core sections as hereinbefore explained.

In using the aforesaid hollow piles, a section of shell will be connected with its section of core and driven as a unit. Then the next section of shell and core will be interlocked with said first section and driven, and so on until the pile is complete. Then the sections of core will be withdrawn one by one. Should there be danger of collapse of the shell while the core is being withdrawn the interior of the shell will be filled with a temporary filling material, such as water, before the core is withdrawn. Finally this temporary filling medium will be removed, and the shell filled with concrete, grout, clay or other suitable material. After withdrawing the core I may insert the temporary skeletonized spacers 30, (Fig. 5) to give additional temporary support to the shells 31, the spacers usually being withdrawn, as the piles are filled with the permanent filling material, or the spacers may be left permanently in the piles.

When the piles are of comparatively small diameters the earth in the interior of their cores may be disregarded, but when the piles are of larger diameter, it will usually be necessary to remove the earth, preparatory to filling the piles with the grout, concrete or other permanent filling, and when the pile is not of very great diameter, and in certain soils, the fixed or integral earth-removing devices shown in Fig. 6 may suffice. In this figure the shell 35 has an annular core 36,

provided, near its lower edge, with an inwardly projecting triangular flange 37, and the shell is bent up at 39 to engage the core. Such a shell and core may each be in one piece, or may preferably be in sections, and my invention of the earth removing devices in annular piles covers both sectional and other piles. It will be understood that after the pile has been driven the core 36 will be withdrawn, the flanges 37 raising up much of the earth as the core is lifted, and thus, by the single operation of removing the core, the pile will be practically cleared of earth and ready for the permanent filling. It will, of course, also be understood that in case of danger of collapse of the shell a temporary filling of water or other material may be employed as well as the spacers 30, as hereinbefore explained. For piles of larger diameters or where the soil is different the carrying flanges may be reinforced or replaced by flexible upwardly projecting pieces 40, 40, Fig. 7 attached at a slight angle from the vertical to the lower end of the driving pieces, or core 41. When driven the said pieces 40 curve towards the vertical as indicated by dotted lines, offering little resistance to penetration, but when they are withdrawn from the permanent shell 42 they are immediately forced into the position of the solid lines A A tending to engage each other at their upper ends, and forming a solid resistance against the material in the core 41 and thus lifting said material, as the core is lifted. According to the conditions and the character of the soil, these members 40 may of course be long enough to engage at their free ends or only project part way to the center of the pile. They may be made of several narrow strips with spaces between, or they may be made with solid sheets of metal forming flaps which entirely close the bottom of the pile and form a regular floor for it, and they may project from one side only or from both sides as shown. A modification of this device is shown in Fig. 8 where the movable members 44, 44 are made much stiffer than above described and are free to revolve through part of a circle about pivots which secure their lower ends to the driving or core piece 45. In this case their upper ends may be designed to engage each other as indicated by the dotted lines, or they may be calculated to revolve farther and engage supports on the opposite side of the pile, or they may be held in place by extension of the lower ends engaging fixed stops.

In Fig. 9 an earth-removing device is shown which involves different mechanical principles. A pair of links 48, 49, are pivoted together at 50 and to the driving piece or core 53, at 56. While being driven the links are shielded by the cutting edge flange 60 and if necessary, by a light flexible apron 61. Lifting rods 63 are attached to the pins at the lower ends of the bottom links 49 whereby the said driving piece or pieces 53 are raised, leaving the outer shell 54 in place. The links 48, 49 are set in the first place, a little out of alinement, and as soon as tension is applied to the bars 63 they begin to act as toggles with a multiplication of power that forces them towards the position indicated by dotted lines, penetrating the earth core so as to lift it with themselves.

In Fig. 10 another device is shown which is made operative by driving of the driving bar or core and is useful in very hard soil, where the earth core can not be as satisfactorily removed by the other devices. The movable piece or finger 70, has a convex bearing 71 at the upper end which engages a recess 73 in the driving piece or core 75. When the pile is driven the lower end of finger 70 is engaged and protected by the upturned bottom portion 77 of the shell 76 which hooks over the bottom of the driving piece or core 75. When it is desired to withdraw the earth core the said driving piece 75 is lifted a little, and when it is free of hook 77 the spring 80 forces the lower end of finger 70 against the core. Driving is then resumed and the end of finger 70 penetrates into the core obliquely and tends to assume the position indicated by dotted lines. Simultaneously the upper end of finger 70 is forced farther and farther outwards in the recess 73 and when driving ceases and the core 75 is pulled up, finger 70 is jammed against the corner 79 of the core 75, and is thus maintained in its inclined position, and supports the earth core so that the latter is pulled up with the piece 75. This device is valuable, because after the core is lifted clear of the ground, a tool can be inserted in recess 73 from the outside, and the finger 70 can be driven inwards until it clears the corner 79, and allows the earth core to freely drop out.

It will generally suffice to leave the lower end of the outer shell open, but in case of quicksand or other troublesome conditions it may be desirable to close it. To effect this closure I provide, when necessary, an upwardly opening valve or valves as indicated in Figs. 11 and 12. The upper end of a flap 80 is hinged to the outer shell 81 and the lower end engages a hook on the lower end of a tension piece 82. When the driving piece or core 83 is withdrawn the pieces 85, or equivalent devices, engage and withdraw the earth core as already described, and as the shoulder 87 rises, it engages the hook on the upper end of the tension piece 82 and by pulling it revolves the valve 80 upwards and then releases it by disengaging the piece 82. Any farther upward movement of the quicksand will cause the valve 80 to move farther until it entirely closes the bottom of the shell, seating against a fixed stop provided but not shown, or until it engages a similar

flap on the opposite side of the shell. In some cases the tension piece 82 may be omitted and the flap 80 may act automatically as a check valve. Various other devices may also be used corresponding substantially to the reversed operation of those shown for extracting the core, in Figs. 7, 8, 9, 10.

The pieces which penetrate and engage the soil or core may be either several comparatively narrow pieces or may be wider continuous plates. In rectangular piles or piers they may be single or double flaps continuous across the full width or breadth of the shell but in circular piles they should be arranged radially.

In order to provide a resistance against external pressure I provide, when necessary, a longitudinal orifice 17 in one or more of the units of the core, through which water, grout or other suitable material may be filled into the shell as fast as the core is removed. I may, of course, also make use of the central orifice of the hollow cores, in some cases, through which to introduce the water, grout or other temporary filling, and it will be understood that when grout is used it will be displaced while still soft, and before it has set, by the permanent filling of concrete, stone or other material. In some cases grout as a temporary filling has advantages over water, because a temporary filling of water tends to dissolve the permanent concrete filling to some extent, while a temporary filling of grout rather improves the permanent filling of concrete.

To facilitate the removal of the soil from the hollow core I make, when necessary, and to facilitate renewals, repairs etc. and for other reasons, the lower part of the core or core units detachable, or I make the pieces which engage the soil in the interior of the core, detachable. These provisions for detaching the engaging members or the lower part of the core, are applicable to all the different forms of cores and withdrawing devices enumerated and described in these specifications.

Now having described my improvements I claim as my invention.

1. The combination with a sectional annular pile, of an annular core therefor composed of a plurality of independently removable sections adapted to be removably engaged with one another and with pile sections before driving, substantially as described.

2. The combination with a sheet metal pile of a core therefor consisting of a plurality of independently movable sections adapted to engage each other, and having interlocking joints on their longer sides adapted to prevent relative transverse displacement, substantially as described.

3. The combination of a hollow pile and an earth raising flange thereon, substantially as described.

4. The combination of a hollow pile and means carried by said pile for removing the earth, adapted to be easily driven into the earth with the pile and to engage and remove the earth core while the pile remains in the earth, substantially as described.

5. The combination in a pile, of a shell, a driving core removably connected therewith and adapted to drive the shell, and earth-removing devices carried by said driving core and adapted to lift the earth within said core as the latter is raised, substantially as described.

6. The combination of a pile and movable earth-lifting devices carried thereby and adapted to enter the earth as the pile is driven, and to be shifted and engage the earth to remove the same, substantially as described.

7. The combination of a hollow pile and pivoted earth removing devices carried thereby and adapted to enter the earth when the pile is driven and to shift and engage the earth to lift the same, substantially as described.

8. The combination in a pile, of a shell a removable core therefor, and movable earth-removing devices carried by said core, and adapted to enter the earth when the pile is driven and to engage and lift the earth when the said core is removed, substantially as described.

9. The combination in a pile, of a shell, a removable driving core therefor, and earth-removing fingers carried by the core positioned to freely enter the earth as the pile is driven, and to shift to a radial position and lift the earth within the said driving core when said driving core is raised, substantially as described.

10. The combination with a pile, of earth-removing devices, carried by said pile and means carried by said pile for operating the same, substantially as described.

11. The combination in a pile, of a shell, a removable driving core therefor, earth-removing devices carried by said core, and means for actuating said devices, substantially as described.

12. The combination of a pile, a removable driving core therefor, and earth removing devices operatively connected with said core, whereby the motion of the core into the earth carries said devices with it, and the motion of the core out of the earth causes said devices to engage with and remove the earth, substantially as described.

13. The combination of a hollow pile, movable devices carried thereby and normally positioned to project forwardly and adapted to move backwardly and close the pile as the same is driven, substantially as described.

14. The combination in a pile, of a shell, a removable driving core, a valve adapted

to close the bottom of the shell, and devices operatively connecting the core and valve whereby the upward motion of the core closes the valve, substantially as described.

15. In a pile the combination with a core of earth-removing devices and a protection therefor carried by said core, substantially as described.

16. In a pile, the combination of a core, a valve for closing the pile and devices for protecting the valve, substantially as described.

17. In a pile, the combination of a shell, a removable core driving a device for removing the earth and a spring adapted to actuate said devices, substantially as described.

18. The combination of a shell, a removable driving core therefor, a device for closing the bottom of the shell and an operative connection for said device adapted to be disengaged from the said core when said core is near the lowest position and to be engaged therewith when said core is substantially above its lowest position, substantially as described.

19. The combination of a shell, a removable driving core therefor, a valve for closing the shell, and a tension piece adapted to engage said core during a part of the movement thereof and close said valve, substantially as described.

20. The combination of a pile, a pivoted earth-removing device carried thereby and means on the pile for engaging said device with the earth as the pile descends, substantially as described.

21. The combination of a shell, a removable driving core, earth-removing devices carried by said core, and means to hold said devices in position to remove the earth, substantially as described.

22. The combination of a pile, devices for removing the earth carried thereby, and means carried by said pile and adapted in one position to hold said devices in operative position, substantially as described.

23. In piling, a longitudinally sectional pile unit provided with a longitudinal filling orifice, substantially as described.

24. In piling, a longitudinally sectional pile core provided with a longitudinal filling orifice, substantially as described.

25. The combination of a longitudinally sectional hollow pile, and a temporary liquid or viscous filling therein, substantially as described.

26. In piling, the combination of a hollow pile and a temporary filling of grout therefor adapted to be displaced while soft by a permanent filling, substantially as described.

Signed at New York city this 18th day of August, 1905.

FRANK W. SKINNER.

Witnesses:
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HENRY H. DE VOS.