L. E. WELSH.

PILE AND MEANS FOR DRIVING THE SAME.

APPLICATION FILED JUNE 19, 1909.

975,487.

Patented Nov. 15, 1910.

3 SHEETS—SHEET 1.

Fig. 1

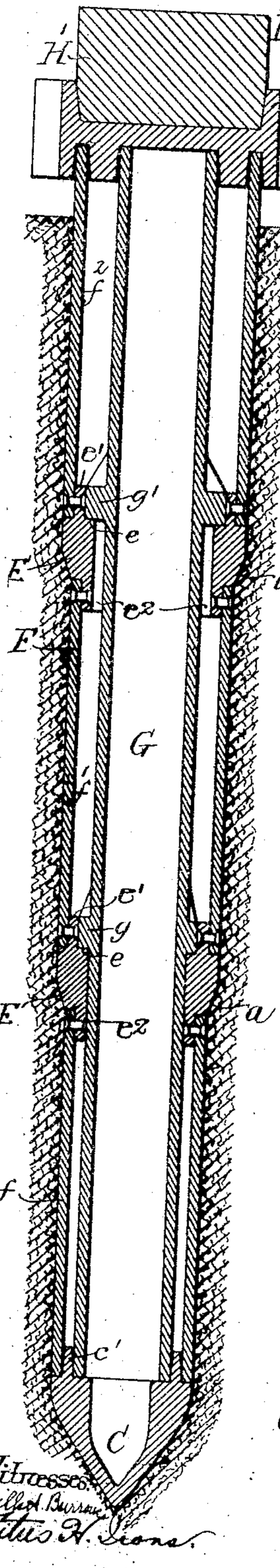


Fig. 2.

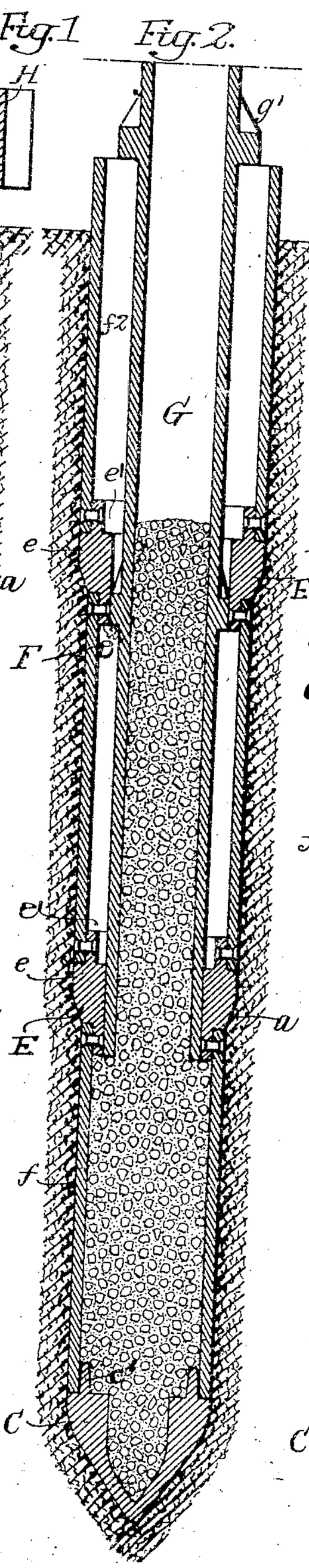


Fig. 3.

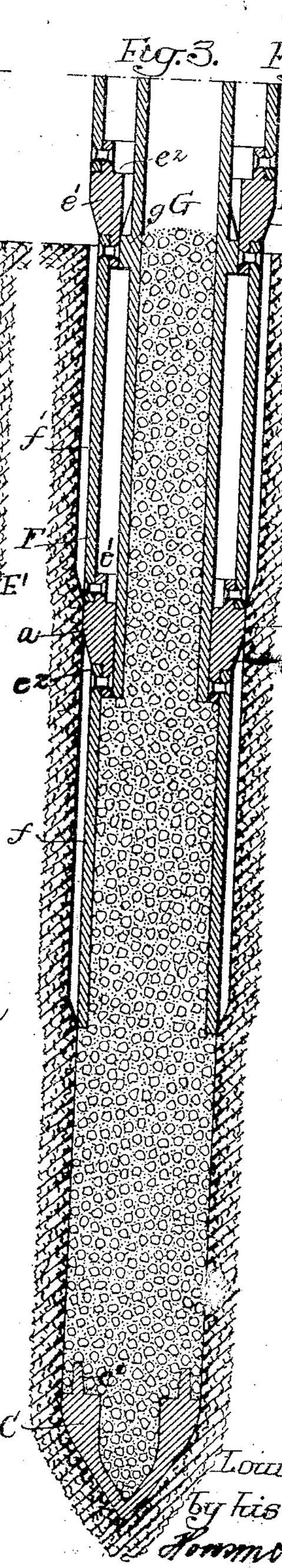
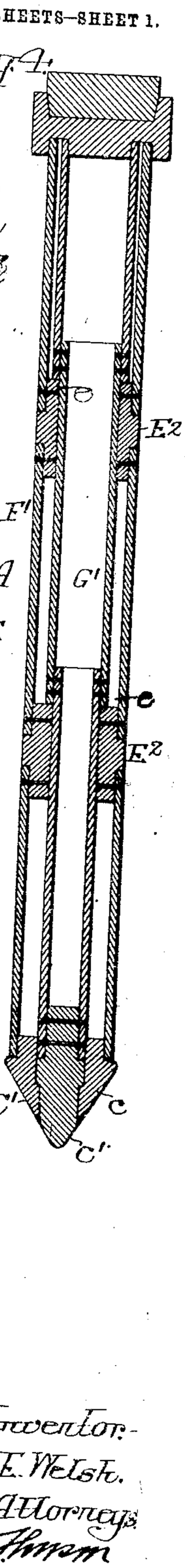


Fig. 4.



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3 SHEETS—SHEET 2.

Fig. 5.

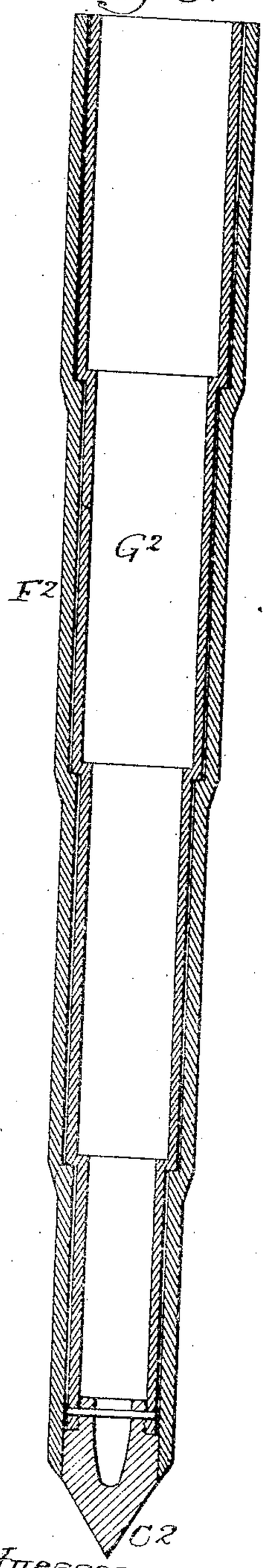


Fig. 6

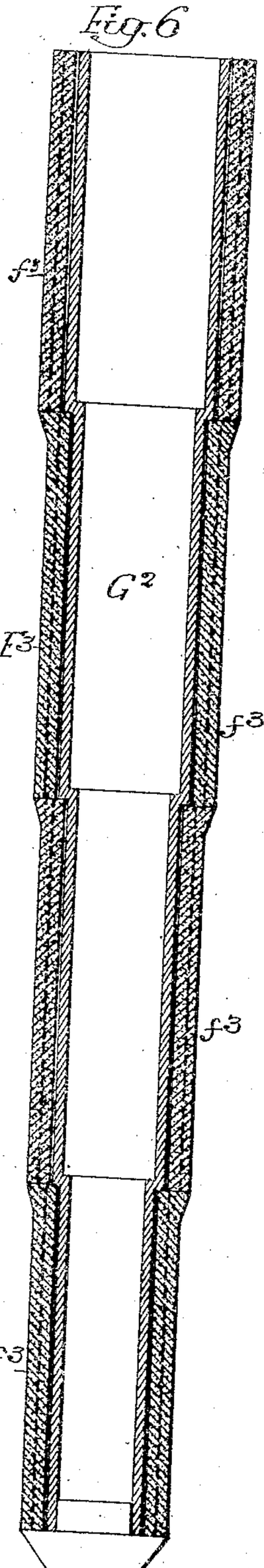


Fig. 7.

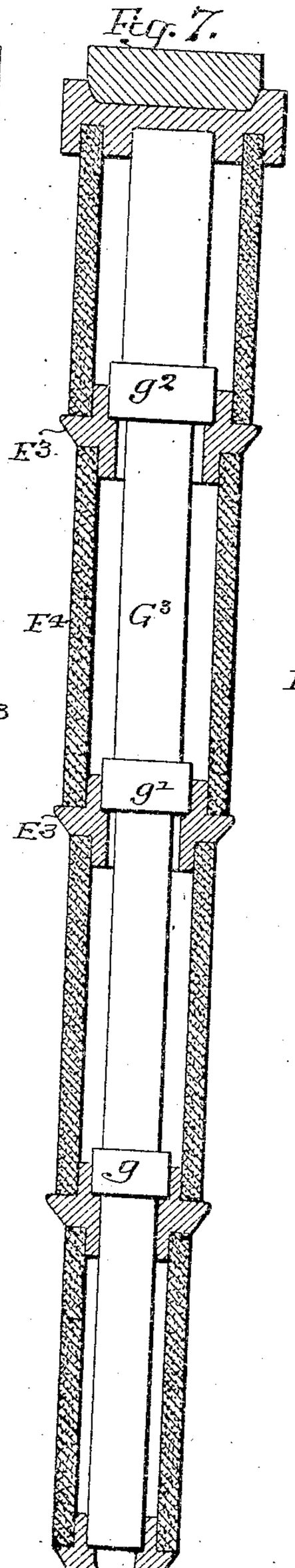
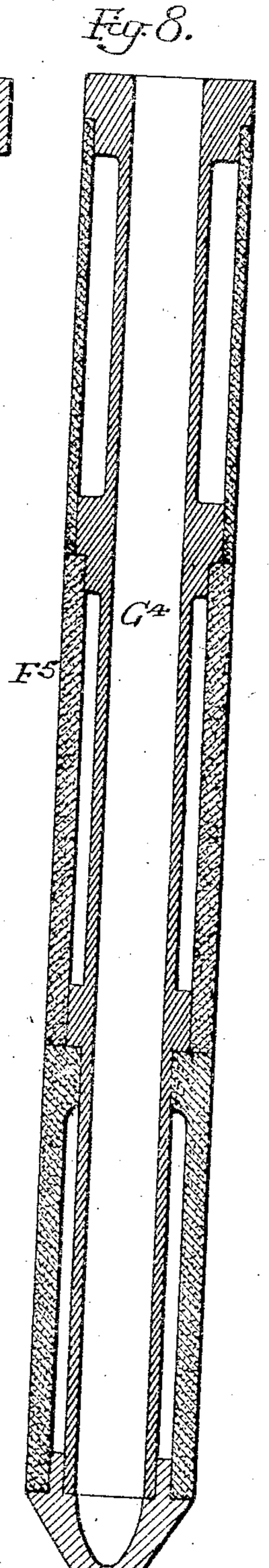


Fig. 8.



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3 SHEETS—SHEET 3.

Fig. 9.

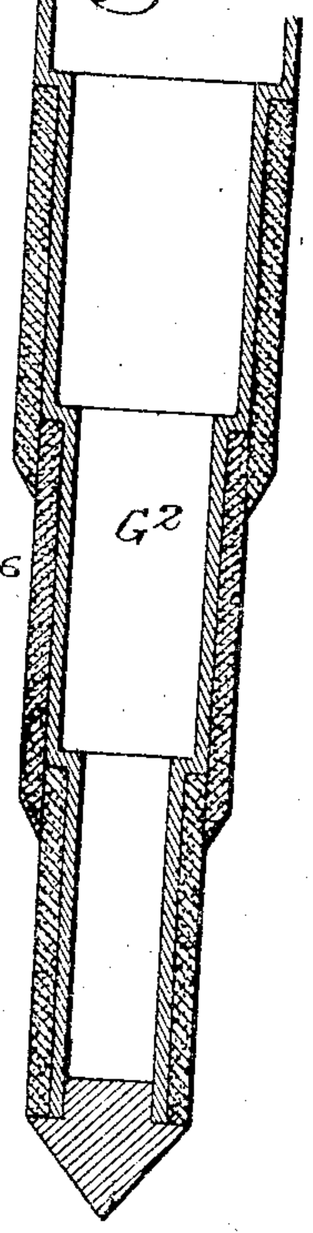


Fig. 11.

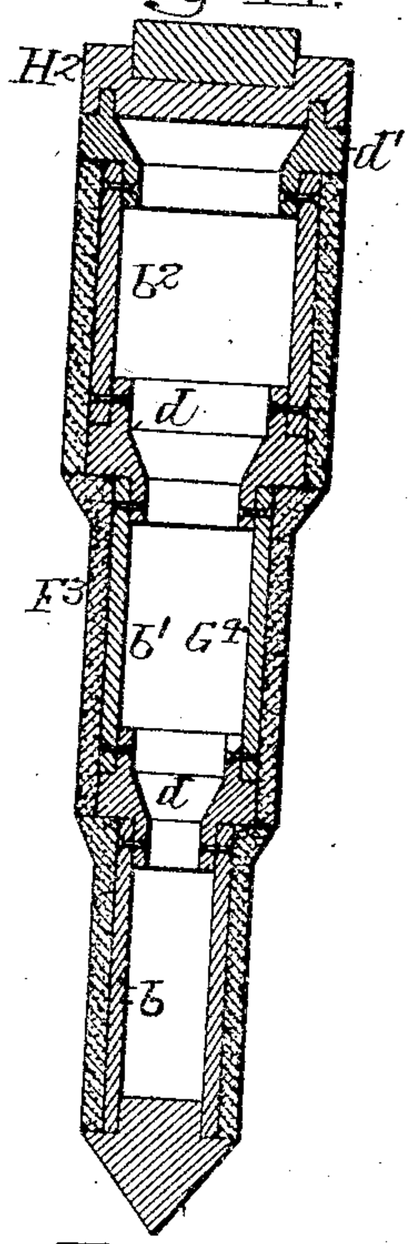


Fig. 12.

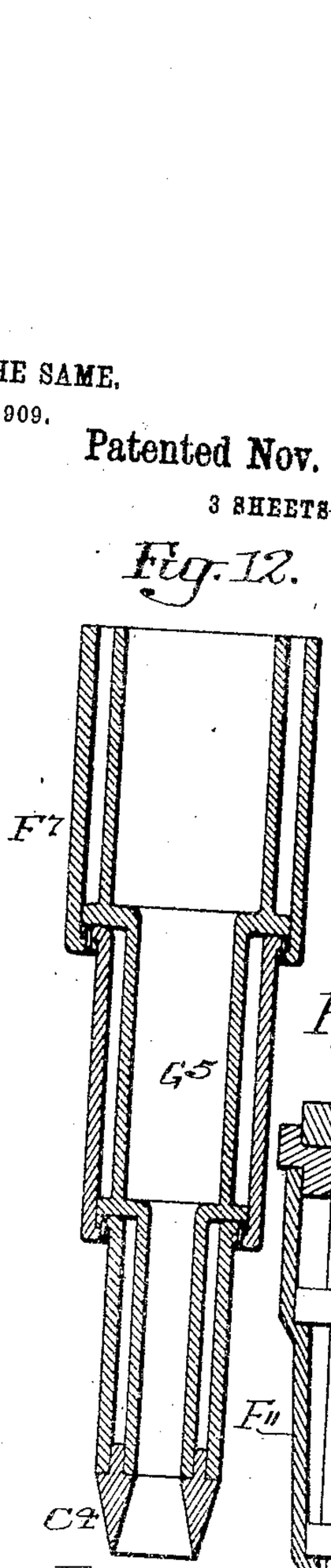


Fig. 15.

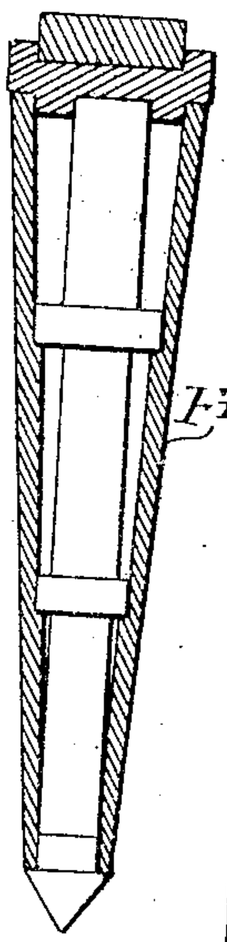


Fig. 16.

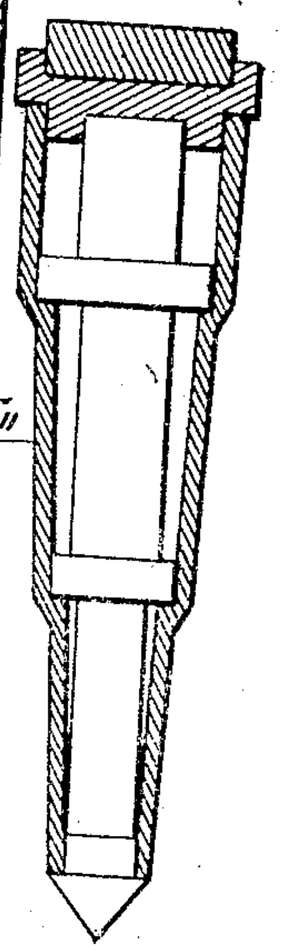


Fig. 10.

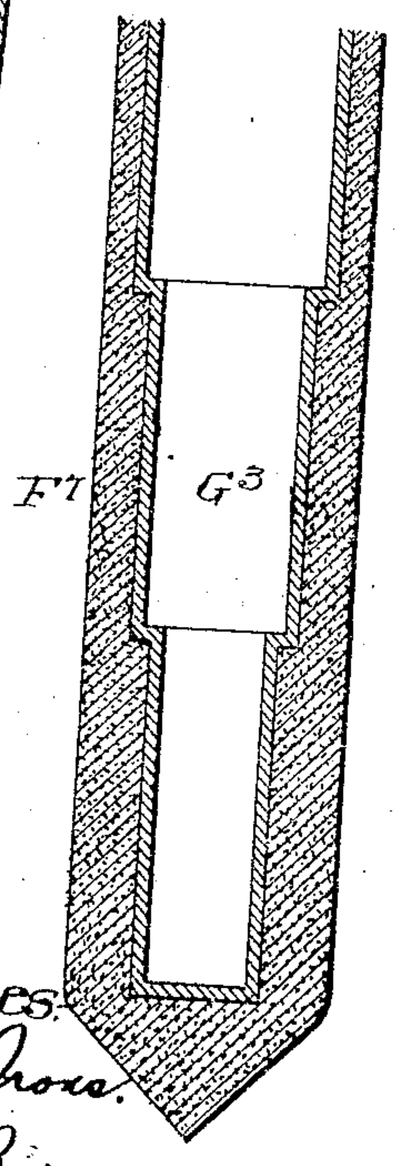


Fig. 13.

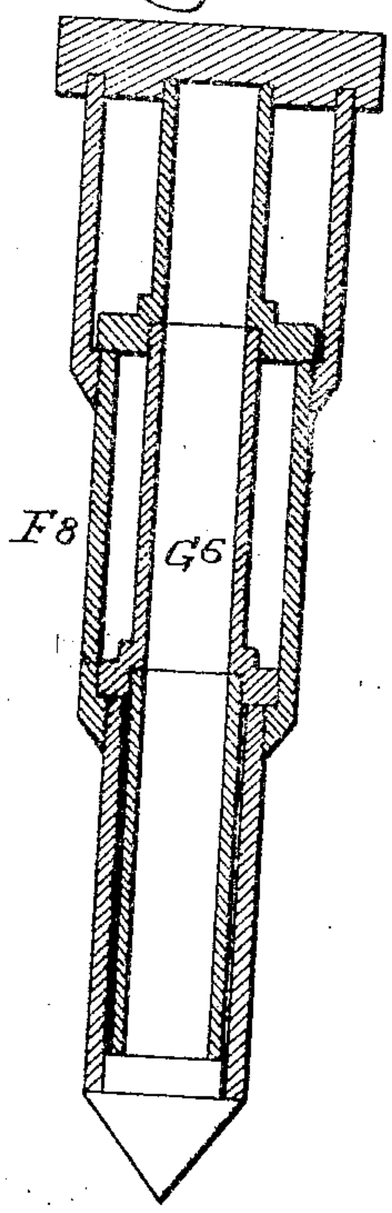
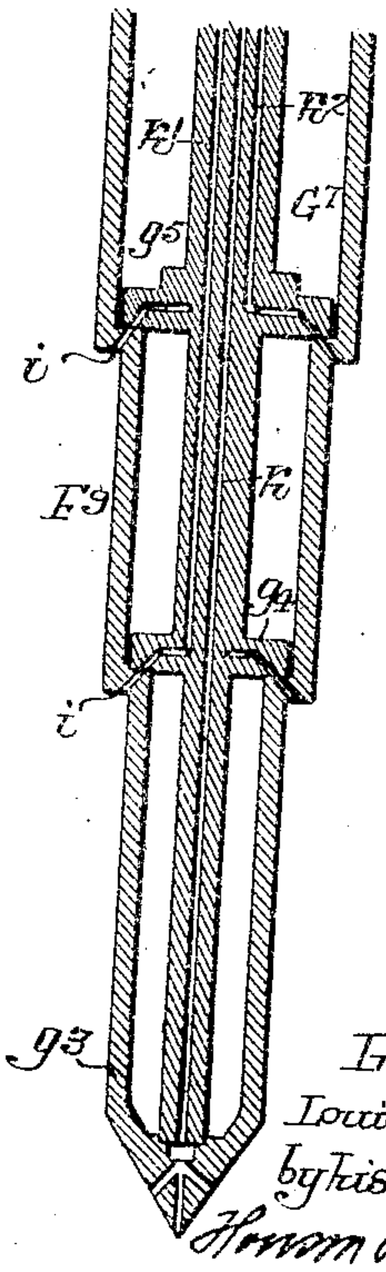


Fig. 14.



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UNITED STATES PATENT OFFICE.

LOUIS E. WELSH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO AMERICAN CONCRETE PILING COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

PILE AND MEANS FOR DRIVING THE SAME.

975,487. Specification of Letters Patent. Patented Nov. 15, 1910.

Application filed June 19, 1909. Serial No. 503,179.

To all whom it may concern:

Be it known that I, LOUIS E. WELSH, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Piles and Means for Driving the Same, of which the following is a specification.

My invention relates to that type of pile to be driven in the ground, in which an inner driving form is used.

The object of my present invention is to so design the pile that the inner driving form will engage the outer driving form or shell at more than one point so as to distribute the blow throughout the length of the pile in contradistinction to driving the pile from either the top alone or at the lower end or point alone.

My invention relates also to a pile having an inner driving form and having outside shoulders. This form of pile is fully set forth and described in an application for patent filed by me on the tenth day of June, 1909, Serial No. 501,356.

In the accompanying drawings, Figure 1, is a longitudinal sectional view of a preparatory pile made in accordance with my invention, the pile is shown as driven in the ground, and of a greater diameter at the top than at the point and having shoulders on its periphery; Figs. 2, and 3, are views illustrating one method of forming concrete piles by the use of the preparatory pile illustrated in Fig. 1; Fig. 4, is a sectional view of another form of preparatory pile of an even diameter throughout; Fig. 5, is a sectional view of a pile, the inner and outer driving forms being made each in a single piece and the point being attached to the inner driving form; Fig. 6, is a sectional view of a pile in which the outer driving form is made up of a series of concrete sections, each section having an outer shoulder; Fig. 7, is a sectional view of a pile in which the outer form is made up of a series of concrete shells separated by metallic rings forming shoulders; Fig. 8, is a sectional view of a pile in which the outer form is made up of a series of concrete shells of different thickness forming inside shoulders, the pile being of an even diameter throughout; Fig. 9, is a sectional view of a pile in which the outer form is made up of a series of concrete shells, one shell overlapping the other; Fig. 10, is a view of a pile in which the outer form is a single concrete shell; Fig. 11, is a view showing a pile in which the outer form is made up of a series of concrete shells and the inner form made up of a series of sections and rings; Figs. 12 and 13, are views of modifications of the pile; Fig. 14, is a view of a pile arranged to be driven and jetted at the same time; and Figs. 15 and 16 are views of tapered piles.

Figs. 1 to 3, illustrate a preparatory pile, that is, a pile driven into the ground to form a hole in which concrete or other material is inserted to form the permanent pile. In this type of pile there is an inner driving form G and an outer driving form F. In some instances the pile can be driven by simply driving on the inner driving form, the blow being transmitted from the inner driving form to the outer driving form and in other types of piles both the inner and outer driving forms can be driven, but heretofore the pile was either driven by driving at the top alone, or driving at the top and bottom, the penetrating point C being directly under the outer driving form.

By my invention I distribute the blow so that the blow on the inner driving form is transmitted to the outer driving form at two or more points throughout the length of the pile.

In the present instance the outer driving form is made up of a series of metallic shells f—f'—f^2 connected to metallic rings E—E', the rings having flanges e'—e^2 to which the shells are secured either by rivets or other fastenings. On the inner edge of each ring is a shoulder e and on the inner driving form G are flanges g—g' adapted to bear upon said shoulders, both the inner and outer driving form rest upon shoulders of the point C which in the present instance has a flange c' which extends into the space between the two forms and holds one central in respect to the other. H is a driving head recessed as shown to receive the upper ends of the inner and outer driving forms and H' is the ordinary cushion used on this type of head. Each of the rings E—E' has external shoulders a—a tapered in the present instance and the several sections f—f' and f^2 of the outer driving form are of different diameters, the lower section being comparatively small and the others increasing in

diameter, as shown, so that the pile of this form is greater in diameter at the upper end or butt than at the lower end or point. The point C of the pile can be of the same diameter as the section *f* of the outer driving from or can be of a greater diameter, as shown in Fig. 4, so as to relieve the first section of undue skin friction.

In some instances the several shoulders may be of greater diameter than the section of pile above it, and in this case the shoulder of the pile is either part of the permanent pile and remains in the ground, or they are made separate from the pile and the sections which are in the form of rings remain in the ground after the preparatory pile is removed.

In driving the pile illustrated in Fig. 1, into the ground the outer driving form is driven not only by the head H but also by the flanges *g*—*g'* and the point C is driven by both the inner and outer driving form so that the initial penetration of the ground is made by the point, and the shoulders or beveled portions *a*—*a* of the rings increase the diameter of the hole in the ground. The hole when formed will increase in diameter from the bottom to the top and shoulders will be formed at intervals which tend to support the load carried by the pile. The hole formed by the pile illustrated in Fig. 1, may be filled in many different ways. In some grounds the preparatory pile after forming the hole can be entirely removed and concrete placed therein by any suitable appliance, or the concrete can be inserted in the pile as illustrated in Figs. 2 and 3, in this instance the tubular inner driving form G is raised, as indicated in Fig. 2, until its lower end is at or near the ring *c*, then concrete is inserted in the pile as indicated in Fig. 2, then the form is raised with the outer form to position illustrated in Fig. 3, and additional concrete is inserted, the first concrete filling the hole and as the two forms are raised the concrete will fill the hole without the liability of its bridging, due to any inner obstruction such as would be the case if the inner driving form was entirely removed and concrete allowed to be dropped into the outer driving form. In this instance, the driving point C remains in the ground and forms the base or point of the permanent pile. By this method of filling, the outer driving form supports the earth and prevents extended caveins, so that the pile is properly made throughout its length. The hole may be filled by raising the inner and outer driving form simultaneously, but if the inner driving form is entirely removed then care must be taken to insure the proper filling of the pile by a rammer or other device.

In Fig. 4, I have shown a pile in which the outer driving form F' is of an even diameter throughout and the rings E^2 connecting the several sections of the pile do not project beyond the surface of the pile. In this instance the inner shoulders *e* are formed on the rings and the inner driving form G' is made of a series of sections secured together. The point C' in this instance is made in two sections *c*—*c'*, the ring section *c* is not attached to either driving form and remains in the ground, but has an inner shoulder upon which the inner section *c'* rests and this inner section is attached to the inner driving form G' and is removable with it. This type of point is fully illustrated and claimed in an application for patent filed by me on the 29th day of December 1908, Serial No. 469,834.

In Fig. 5, I have shown the outer and inner driving forms F^2 and G^2 made of a single piece and each having shoulders so that the inner driving form will engage the outer driving form and the outer driving form has also the beveled external shoulders. The point section C^2 in this instance is mounted within the end of the outer driving form and is connected rigidly to the inner driving form and removable with it so that when the inner driving form is removed and the hole filled through the outer driving form no portion of the point remains in the ground.

In Fig. 6, I have shown an inner driving form similar to that illustrated in Fig. 5, with an outer driving form F^3 made up of a series of concrete sections f^3 and these sections or shells increase in diameter from the point to the butt of the pile, forming inner shoulders upon which the inner driving form rests and in this instance the outer shoulders are formed on the upper end of each section, these shoulders being beveled in the present instance. The shells are also preferably reinforced by any suitable reinforcing material.

In Fig. 7, I have illustrated an outer driving form F^4 made up of a series of concrete shells of different diameters and metallic rings flanged somewhat similar to the rings illustrated in Fig. 1; in this instance the rings are not connected to the shells. The inner driving form G^3 has flanges *g*—*g'* and g^2 which bear upon the inner shoulders of the rings and the inner driving form also bears upon the point C^3. In this instance the outer driving form remains in the ground with the point and the rings. I have also illustrated each ring section of greater diameter than the concrete section above it so as to relieve said section of skin friction.

In Fig. 8, I have shown a pile in which the outer form F^5 is of an even diameter throughout and the concrete sections of this pile decreased in thickness from the bottom to the top thus forming inner shoulders for the flanges of the inner driving form G^4, the

sections of the outer driving form being held central by a snug fit on the inner driving form. In all the piles in which the outer driving form is made up of shells of concrete, the shells are not subjected to the crushing strains due to the blow of the pile driver.

In Fig. 9, I have shown the inside driving form G^2 made similar to that illustrated in Fig. 6, and the outside driving form F^6 made up of a series of concrete shells one overlapping the other and each section beveled at its lower edge to form the outside shoulder, the inner shoulder being formed by the end of the section.

In Fig. 10, I have shown a driving form G^3 similar to that illustrated in Fig. 9, with the exception that the lower end is closed at the bottom and in this figure I have shown a concrete outer form F^7 made in a single piece including the point, and this single piece may be reinforced in any manner desired and in some instances the outer driving form may be made in sections divided at the shoulders.

In Fig. 11, I have shown an inner driving form G^4 made up of a series of shells b—b' and b^2 connected together by rings d; the upper end has a ring d' adapted to receive the driving head H^2. The outer form F^8 in this instance is made up of a series of concrete shells, but the shells may be of metal, if desired when both forms are to be simply preparatory piles.

In Fig. 12, I have shown the inner driving form G^5 made of a single piece flanged, the form increases in diameter from the point to the butt and the outer driving form F^7 is made up of a series of sections, one section having internal flanges at one end and external flanges at the other end, the flanges of one section overlapping the flanges of the other and the two sections are preferably secured together by rivets or other fastenings. In this instance the point C^4 is made in the form of a ring with an open center; by this arrangement the earth passes into the inner form and can be removed therefrom by any suitable means, the point in this instance is loose and remains in the ground.

In Fig. 13, I have shown the inner driving form G^6 made up of a series of flanged sections connected together by screw threads and the outer form made up of sections secured together by screw threads, the lower ends of each of the sections being beveled forming the outer shoulders.

In Fig. 14, I have illustrated a pile which can be driven and simultaneously jetted into the ground, in this instance the outer driving form F^9 is made in a single piece having shoulders at intervals and passageways i at the shoulders for the jetting streams of water. G^7 is the inner driving form having independent channels k—k' and k^2 which communicate with the point g^3 and the several heads g^4 and g^5, the point g^3 being part of the outer driving form in the present instance and having channels so that as the pile is driven the water is admitted first to the point, then as the first shoulder reaches the ground, water is admitted under this shoulder through the passage k', then when the second shoulder reaches the surface of the ground, the water is admitted to this shoulder through the passage k^2 so that by this means the pile can be very quickly driven as the ground under the point of the pile and under the shoulders is disturbed by the jets of water.

Fig. 15 shows a pile in which the outer driving form F^{10} is tapered and has a series of inner shoulders for the flanges of the inner driving form.

Fig. 16 shows a pile in which the outer form F^{11} is tapered and has a series of outer shoulders, the inner driving form bearing upon inner shoulders on the outer driving form.

It will be seen by the several constructions above mentioned that the inner driving form bears upon shoulders on the outer driving form between the point and the butt of the pile, thus distributing the pressure and where a concrete form is used the inner driving form prevents the crushing of the section of the outer driving form.

In an application filed October 15, 1910, Serial Number 587,173, I have described and claimed a process of preparing concrete piles in the ground in the use of which certain of the forms disclosed herein may be employed.

I claim:

1. The combination of an inner and an outer pile form, the outer form having a series of internal shoulders and the inner form having flanges engaging the upper surfaces of said shoulders to exert a downward pressure, whereby the driving blow will be distributed over a plurality of points.

2. The combination of a non-expanding outer form, an inner form, a point on which both forms rest, the outer form having an internal shoulder disposed between said point and the upper or butt end of said form and the inner form having a portion engaging said shoulder so as to exert a downward pressure when the forms are driven.

3. The combination of an inner and an outer driving form, each having a series of engaging shoulders and being disconnected so that after they are driven the inner form can be removed without disturbing the outer form.

4. In a pile, the combination of inner and outer driving forms, each having shoulders located between the point and butt end of

the pile, the shoulders of the inner form resting upon the shoulders of the outer form so as to distribute the driving blow and the shoulders of the inner form being such that said form can be withdrawn without disturbing the outer form.

5. In a pile, the combination of an outer form, an inner form and a point, said inner form being provided with laterally extended portions for driving engagement with the outer form at one or more places between the point and butt whereby a driving blow imparted to said inner form to force the structure into the ground is transmitted to the outer form at a plurality of points.

6. The combination, in a pile, of an outer form increasing in diameter from the point to the butt and having shoulders successively increasing in diameter and an inner driving form engaging a plurality of said shoulders.

7. The combination in a pile, of an outer driving form increasing in diameter from the point to the butt and having a series of zones separated by beveled shoulders, with an inner driving form engaging the outer shell at the shoulders.

8. The combination in a pile increasing in diameter from the point to the butt, said pile having an outer form consisting of a series of zones separated by a series of beveled shoulders, a point, and an inner driving form resting on the point and having enlargements resting upon the outer driving form at the shoulders.

9. The combination in a pile increasing in diameter from the point to the butt and having a point section, of a series of shells of different diameters connected together by rings forming shoulders, and a driving section resting upon the point and having projections engaging the shoulders of the connecting rings to impart the driving force thereto.

10. A preparatory pile consisting of an inner driving form, an outer driving form having a series of internally disposed shoulders, the inner driving form having shoulders engaging and transmitting the driving force to a plurality of said shoulders, and a detachable point in driving engagement with both forms.

11. The combination in a preparatory pile, of an inner and an outer driving form, the outer driving form having a series of annular shoulders increasing in diameter from the point to the butt and having inner shoulders, with an inner driving form having projecting flanges adapted to bear against the inner shoulders.

12. The combination in a preparatory pile, of an inner and an outer driving form, the outer driving form being made up of a series of sections increasing in diameter from the point to the butt, with tapered shoulders dividing the sections and having a series of inner shoulders, an inner driving form having a series of circular flanges bearing upon the inner shoulders, and a point extending under both the inner and outer driving forms.

13. The combination, in a preparatory pile, of an inner driving form, an outer driving form, said outer form increasing in diameter from the point to the butt and having a plurality of internally disposed shoulders, and a tubular inner driving form having shoulders for driving engagement with the shoulders of the outer driving form at a plurality of places.

14. The combination in a preparatory pile of a series of continuous walled shells of different diameters increasing from point to butt, a series of rings connecting the shells, each ring having an upper and lower flange of different diameters to which said shells are connected and an inner flange forming a bearing, an inner driving form having a plurality of shoulders arranged to engage the inner flanges of the ring sections, and a detachable point section.

15. The combination, in a pile, of an inner driving form and an outer driving form, said outer form being made up of a series of concrete shells arranged one above another and having internal diameters increasing from point to butt providing internal shoulders at their meeting points, and the inner driving form having flanges for driving engagement with the shoulders of the outer driving form.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

LOUIS E. WELSH.

Witnesses:
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WM. A. BARR.