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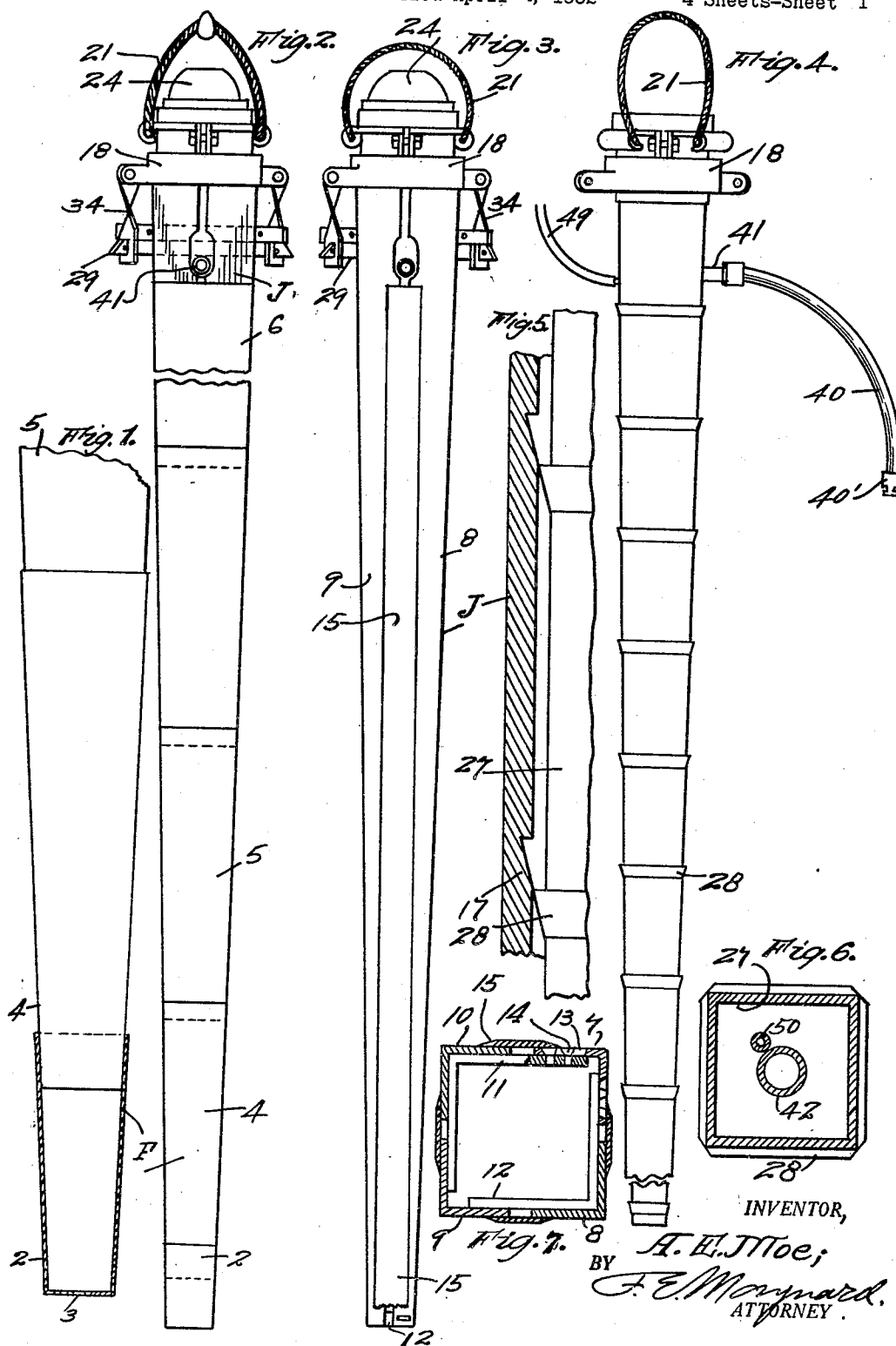
A. E. MOE

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METHOD AND APPARATUS FOR PLACING FORMS FOR GREEN CEMENT FOR PILES

Filed April 4, 1932

4 Sheets-Sheet 1



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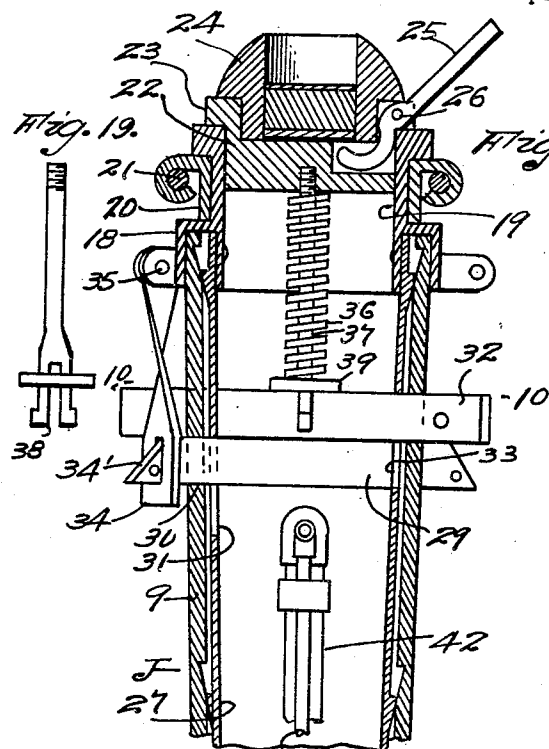
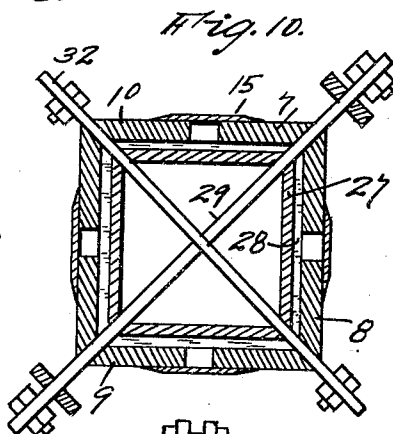
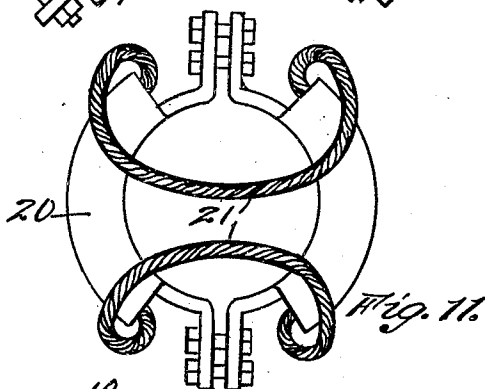
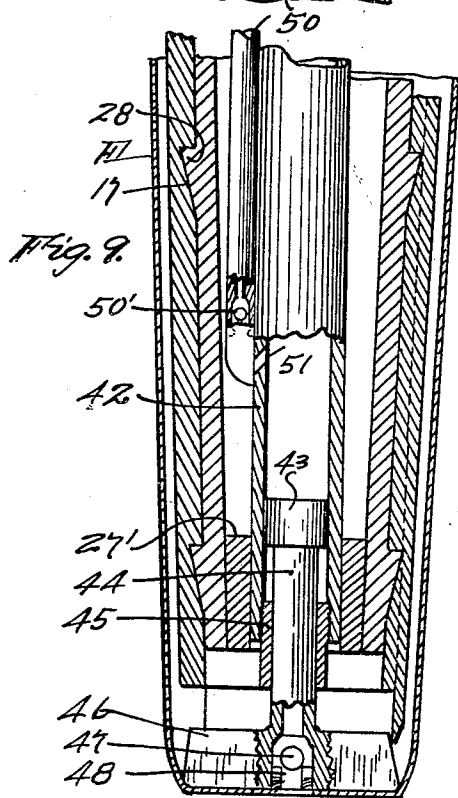
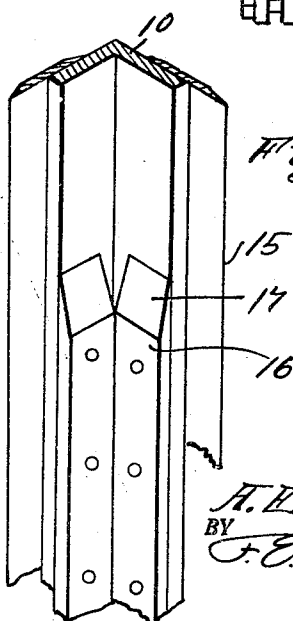
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4 Sheets-Sheet 2



INVENTOR,
A. E. Moe;
BY
F. E. Maynard,
ATTORNEY.

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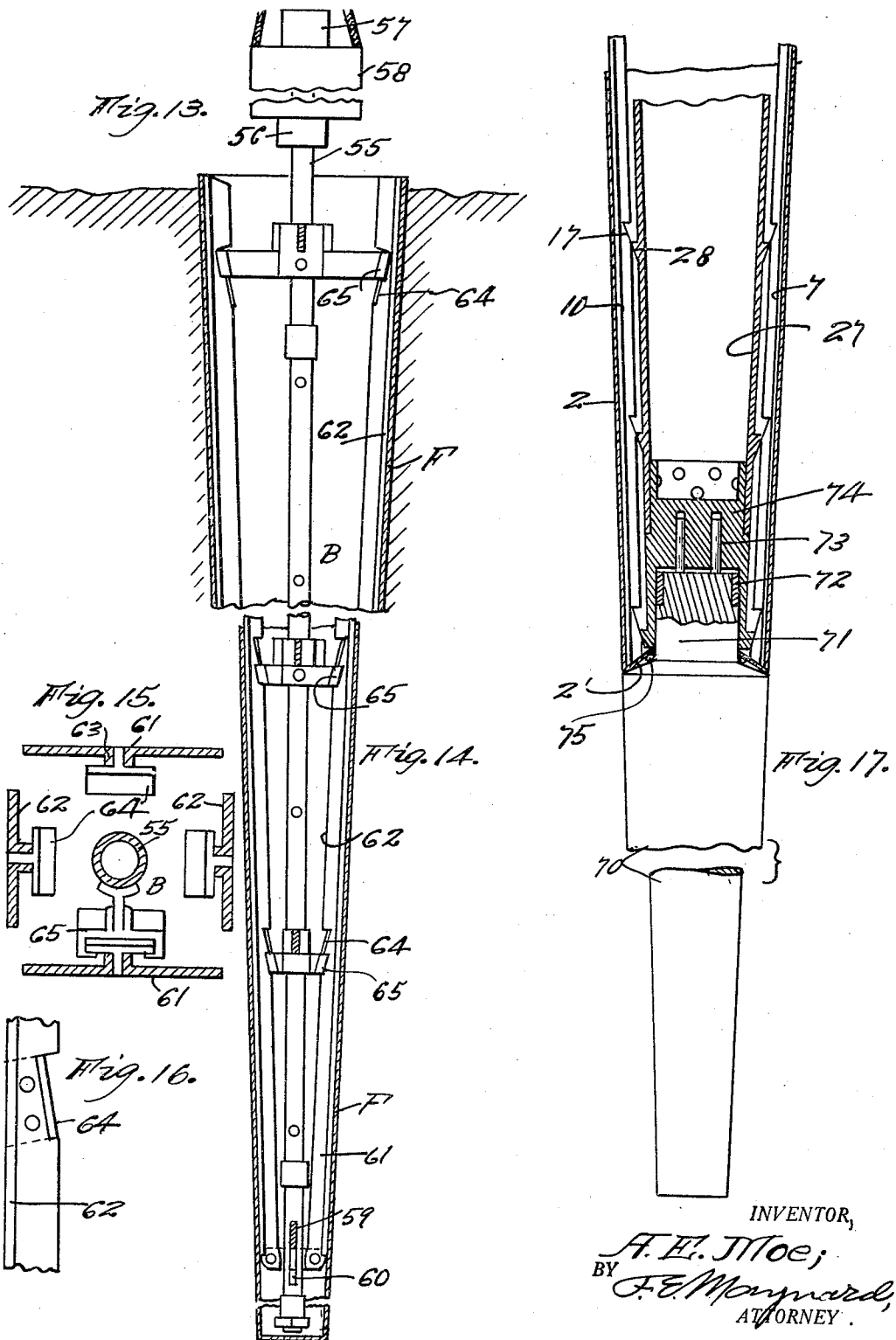
A. E. MOE

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4 Sheets-Sheet 3



INVENTOR,
A. E. Moe;
BY
F. E. Maynard,
ATTORNEY.

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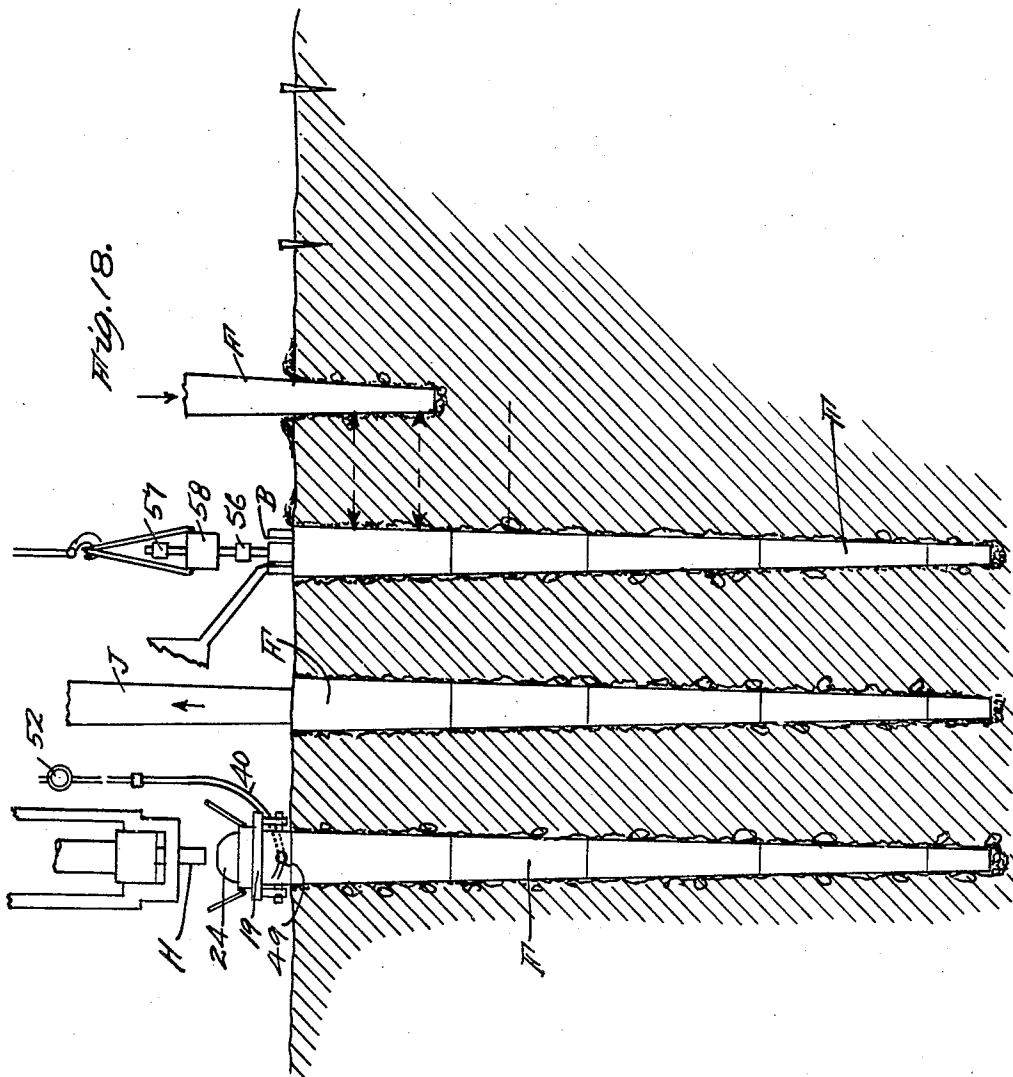
A. E. MOE

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METHOD AND APPARATUS FOR PLACING FORMS FOR GREEN CEMENT FOR PILES

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4 Sheets-Sheet 4



INVENTOR,
A. E. Moe;
BY *F. E. Maynard,*
ATTORNEY.

UNITED STATES PATENT OFFICE

ANTON E. MOE, OF LOS ANGELES, CALIFORNIA

METHOD AND APPARATUS FOR PLACING FORMS FOR GREEN CEMENT FOR PILES

Application filed April 4, 1932. Serial No. 602,934.

This invention relates to the placing of concrete piles, and more particularly pertains to a method and apparatus for placing forms for reception of green cement which upon solidification becomes a rigid monolith of concrete. It is an object of the invention to provide a method and apparatus for the erection, in place in the ground, of a concrete pile.

It is a broad object of the invention to greatly simplify current practices followed to effect the sinking of a pre-cast concrete (or other) pile.

A generally practiced system followed for sinking a pre-cast concrete pile consists in gradually lowering a water jet nozzle into the ground, the water being discharged under a high pressure and velocity from the foot end of an appropriate apparatus so as to hydraulically bore a hole of sufficient depth and of a diameter to permit the subsequent driving of a pre-cast concrete pile. It will be seen that such practice requires several time-consuming operations including the siphoning of the water from the hole after it has been bored by the jet. During such hydraulic boring operation, gravel and boulders which are cut loose naturally gravitate down as the hole is bored if they are of such size that the up-flowing stream of spent water is unable to carry them to the top of the hole.

The accumulation of the gravel and boulders in the bottom of the hole presents an effective barrier when the pre-cast pile is lowered into the hole and driven toward desired grade as by a pile driver.

It is, therefore, an object to provide means and to provide a method whereby the hole is prepared down to desired grade and the encountered over-size gravel and boulders are caused to be thrust aside from the foot of the advancing jet apparatus instead of being permitted to accumulate naturally at the bottom of the hole as this is flushed out.

An object is to provide a method in which there is employed a thin sheet metal form applicable, in sections, to a driving apparatus whereby a hydraulic jet is produced at the foot of the form and the whole is pro-

gressively lowered into the hole either by free action of gravitation or by accompanying percussive effort of a hammer apparatus as will be determined according to the nature of the ground into which the form and boring apparatus is lowered.

A further object is to provide a method and apparatus in which the sunken form is thoroughly reenforced against collapsing pressure as is sometimes set up, either by the nature of the earth in which it is planted or by reason of transmission of pressure incident to the driving of the boring apparatus into the ground in such close proximity to the previously planted hollow form as to cause the intervening earth formation to crush in the thin-walled form.

A further object is to provide for the pouring of plastic cement into the planted form while the form reenforcing, supporting means is still in place so that advantage of the stabilizing presence of the poured plastic will be available before the form supporting means is removed.

An additional object is to provide for the education of residue water in the form sinking apparatus so as to obtain a substantially dry hole in the plant form before the plastic cement is poured.

The invention consists in certain advancements in this art as set forth in the ensuing disclosure and having, with the above, numerous additional objects and advantages as hereinafter disclosed, and whose construction, combination and details of means, and the manner of operation will be made manifest in the description of the herewith illustrative embodiment; it being understood that modifications, variations and adaptations may be resorted to within the scope, principle and spirit of the invention as it is more directly claimed hereinafter.

Figure 1 is a side elevation and partial section of a fragment of the pile form in assembled position of sections.

Figure 2 is a side elevation of the pile form as in position upon a driving unit; the figure indicating a break in the length of the device.

Figure 3 is a side elevation of the driv-

ing unit free of the form and showing its expandible jacket in expanded, form-receiving position.

Figure 4 is a side elevation of the jacket 5 expanding core; the figure indicating a break in length.

Figure 5 is a detail, sectional view showing the driving unit jacket as in expanded relation by the core.

10 Figure 6 is a cross section of the core and the central jet pipe line.

Figure 7 is a cross section of the expandible jacket, with parts in expanded position.

Figure 8 is a detail, longitudinal section 15 of the upper portion of the driving unit, with parts in expanded position.

Figure 9 is a longitudinal section of the lower portion of the driving unit with the parts collapsed within a planted form.

20 Figure 10 is a cross section through the upper part of the driving unit and showing placed lock bars fastening the parts in the position shown in Fig. 8, the plane of the section being on line 10-10, Fig. 8.

25 Figure 11 is a plan of the detached cable collar of the driving unit.

Figure 12 is a perspective of a fragment of an element of the expandible jacket of the driving unit showing a preferred form of 30 structure.

Figure 13 is a longitudinal section of the upper end of a planted form and showing a reenforcing or collapsible support therefor in collapsed relation, and

35 Figure 14 is a longitudinal section of the lower portion of the planted form showing its reenforcing support in effective position.

Figure 15 is a cross section of the form support, some parts being omitted.

40 Figure 16 is a detail of a fragment of a form support buttress.

Figure 17 is a side elevation and partial section of a composite, wood and cement pile, showing the form support in expanded 45 position in the concrete form part of the pile.

Figure 18 is a diagrammatic, sectional view showing steps in the method and operation of the apparatus.

50 Fig. 19 is a detail view of a clamp post of the lead.

In the present method and apparatus, there is employed a metallic core or form consisting, preferably, of a plurality of sheet 55 metal sections including a closed bottom foot section 2 having a water jet hole 3. This section diverges in size toward its upper end to telescopically nest tight on an intermediate section 4, and this likewise telescopes 60 on the lower, smaller end of an adjacent section 5, and so on to the topmost section 6, Fig. 2. These sections are preferably made of rather thin sheet metal and are of a length so that they may be easily handled 65 by one laborer and can be slipped successive-

ly, top section 6 first, and so on, onto a driving unit which includes an expandible jacket whose cross section conforms to the cross section of the above-mentioned concrete form, hereinafter referred to as form F. 70

The present form F and jacket are of square, cross section and taper from top to bottom at any desired degree and length as determined by the ultimate concrete pile 75 which is cast in the planted form F.

The jacket, as shown, includes a quadrangular system of angle iron limbs 7, 8, 9 and 10, which are expandible to solidly thrust outward against the applied form F. The jacket limbs are of suitable length and are 80 adapted to be contracted so as to freely draw from the planted form F.

As shown in Fig. 7, the lower ends of the jacket limbs 8 and 10 have rigidly secured foot bars 11 and 12, and these are outwardly 85 overlapped by flanges of the limbs 7 and 9; these being provided with slots 13 in which play retaining heads 14 of rivets or bolts fixed in the contiguous ends of the connecting bars 11 so that the several limbs 7, 8, 9 and 10 may move out or in as desired. 90 The contiguous edges of the several adjustable limbs are overlapped by shields or guards 15, clearly shown in Fig. 12, and in which the inside faces of the angle limbs 95 (as 7) are provided with reenforcing strips 16 whose upper ends are inwardly and downwardly beveled at 17 for a purpose about to be described.

Thus the lower ends of the expandible 100 jacket, hereinafter referred to as jacket J, are interconnected for limited expanding action. The upper ends of the limbs of the jacket J are provided with a desired telescopic stroke inside of a hood 18 forming a 105 part of a driving head 19 about which is removably secured a two-part collar 20 for bights 21 of a cable loop which is hitched to suitable hoisting tackle in the operation of the apparatus. The driving head 19 is 110 closed by a removable driving plate 22 having a top rim 23 seating on the crown of the driving head 19 and being countersunk to receive the conventional driving block 24 of a common pile driver. 115

A feature of the present invention includes a throw-out device comprising a lever 25 pivoted at 26 on the rim 23 of the driving plate 22 and adapted to be rocked so as to 120 hook under the driving block 24 and throw this out of the driving plate 22, thereby eliminating much labor in the conventional method of removing the driving block.

Rigidly secured in the hood 18 of the driving head 19 is a core structure incorporating 125 means for effecting the expansion of the jacket J and permitting the collapse of the jacket. This core structure, in cross section, corresponds to the cross section of the jacket interior and, as shown in Fig. 6, is in the 130

form of a rigid rectangular box 27 along the external face of which are provided numerous spaced expanding wedges 28 complementary to opposed, inclined cam faces 17 of the several limbs constituting the jacket J.

In preparing the driving unit for operation, the jacket limbs 7, 8, 9 and 10 are shifted into place upwardly so that their top ends butt the top wall of the hood 18, and in such position, the expanding wedges 28 and cams 17 cause the outward or expanding action of the elements and sustain them in expanded position and complementary to the size and form of the interior of the metallic form F whose parts are positioned firmly into place on the downwardly convergent, expanded jacket J.

For the purpose of retaining the expanded jacket in effective position during the lowering and driving of the form F, a lower lock bar 29 is passed through respective holes 30 in diagonally opposite corner limbs 7 and 9 of the jacket, and the contiguous corners of the inside core or box 27 have slots 31 of a length permitting the upward movement of the core, as to the jacket J, so as to permit the collapse of the limbs of the jacket when desired.

A diagonally extending lock bar 32 likewise secures jacket limbs 8 and 10 for concurrent movement with the limbs 7 and 9, as to the core 27 whose relative corners are provided with slots 33 for upward movement of the core as to the lock bar 32.

When the jacket J has been expanded, it is then locked by means of hook links 34 adapted to drop over the beveled ends 34' of the lower lock bar 29, and thus connect the latter to the head 19 from which the lock links 34 are suspended by pivots 35. It will be seen, therefore, that the driving unit including the core 27 and the jacket J can be hoisted clear of the ground to permit application of the form preparatory to lowering and driving the form.

In order to eliminate undue wear of parts due to violent vibration, the lock bars 29 and 32 are constantly under firm seating pressure of a strong spring 36 surrounding a post 37 fixed to the driving plate 22 and having a yoke end 38 straddling the bar 32 on which rests a washer 39 engaged and pressed down by the spring 36. This allows the ready application of the driving head parts to the assembly after the lock bars 29, 32 are in place.

In order to instantly free the driving core 27 from the expanded jacket from the planted form F, it is only necessary to trip the connecting links 34 from the lower lock bar 29 and thereafter, the core is hoisted, and on its initial movement, the expanding cams 17 and 28 by relative movement allow the jacket limbs to collapse which they will

do instantly under the pressure to which the planted form F is subjected.

After a form has been assembled on the expanded jacket J and this is lowered to bring the foot of the form into position over the engineer's mark or peg at the site where the pile is to be driven, water under high pressure is turned into a hose 40 which is connected to a fixed nipple 41 directed outwardly from the core 27 and connected to a central water pipe line 42 which extends to the bottom of the core or box 27 and is fixed in a foot block 27' therein.

Working in the lower end of the water pipe 41 is a head collar 43 of a jet pipe 44 working in a guide bushing 45 and formed on or secured to a drive block 46 which is shaped to conform to the lower end of the jacket section 2. In this drive block is an upwardly closing check valve 47 to prevent the passage of soil or other object upwardly in the jet opening 48 of the block 46; the jet valve 47 opening downward readily as a stream of water under high pressure is forced down the water pipe 42.

Thus, by the present method, as the drive unit with an applied form F is brought to position over the engineer's mark, the hydraulic jet of water at once begins to bore downward, and as the hole is cut the unit is lowered; the upward flowing stream of water cutting its own channel about the sides of the downwardly pressing form on the lowering and driving unit. At such levels as may be desired, a pile driving hammer H may be employed to jolt down the unit in aiding hydraulic boring action.

When the pile form has been driven to grade, the lock bar links 34 are tripped from the bars and the jacket automatically collapses in readiness for pulling of the unit from the planted form F.

It is desirable to provide a dry hole or chamber in the planted form F, and for this purpose, steam from a steam hose 49 is turned into a steam pipe 50 which is fixed to the side of the water pipe 42 and which latter is provided with an upwardly and inwardly directed steam hole 51 at the end of the steam pipe 50 so that steam directed into the hole close upwardly and initiates a siphonic flow of the water from the form F. A check valve 50' prevents flow of water to the steam pipe 50 when this is out of use.

When the water is to be siphoned out, it flows from the hose 40 whose distal end 40' is provided with any suitable form of quick coupling device; this coupling device being broken from a water supply line from a pump or other source of high pressure as soon as service of the water to the pipe line 42 is to be dispensed with, then the discharge end 40' of the hose 40 allows the free dispersing of the water as it is siphoned by steam action from the form.

It is understood that the steam hose 49 will be connected to the driving unit only for the short period during which the water is to be expelled from the planted form F.

5 A review of the operation is as follows: When the core is picked up by the hoist of the pile driver (not shown) the casing or form sections are slipped onto the expanded core jacket. Then the unit is lowered to the
10 ground at the engineer's mark and water is turned in through the high-pressure, connected-up hose line 40 with the result that the high-pressure jet discharged from the jet hole 3 in the bottom of the form will act
15 to cut a hole ahead of the unit, and if this is not fast enough, the unit can be driven by action of the pile driver hammer. When the unit is down to about one foot from the bottom or grade, then the jet of water is
20 shut off and the check valve in the driving block 46 will automatically close the jet line to prevent its being clogged by entering matter.

As soon as the jet is turned off, the core
25 unit, with applied parts, is driven down to final grade, and then steam is turned into the steam line to discharge the water through the water line to make a dry hole. Then the form jacket J is collapsed and
30 pulled with the core from the form.

Preferably, an engineer's pressure gage 52 in the water line hose 40 is provided to show water pressure so that hammer action can be reduced to permit jet of water to cut
35 ahead of the driving unit when this is necessary. By using the hammer to drive the unit at the same time the jet is running, oversize gravel and boulders are hammered aside from the path of the driving end of the
40 form F.

After the planted form F has been exhausted of water, there is then lowered into it a buttressing expander which includes a vent pipe stem 55 open at the bottom and
45 having spaced jar collars 56—57 on its upper end and between which operates a hammer 58 to jar the stem up or down as needed. The foot end of the stem is crossed by bars 59 working in slots 60 and on whose ends
50 are pivoted pairs of buttress strips 61—62 which have central, inwardly directed webs 63. To these webs are secured upwardly and outwardly inclined flanges 64 which are enveloped by boxes 65 rigidly secured to the
55 stem 55 at suitable distance according to the spacing of the cam flanges 64 of the buttress strips.

Piles are commonly driven in rows and it is desired to prevent crushing of the thin
60 walls of the planted forms F when these forms are so close that lateral pressure from the form being driven will be transmitted through the earth formation to the adjacent side of the previously planted form. To
65 that end, the buttress strips 61 are nearly as

wide as the form wall, while the strips 62 are somewhat narrower. When the forms are driven, the wide sides of the expanding buttresses are arranged to stand in plane
70 transverse to the line of the pile row.

In operation, the contracted buttress tool B is lowered into the form F until the pivoted ends of the strips engage in the small end of the form, then the strips are expanded by relative downward stroke of the
75 stem with the cam boxes 65 so as to jam the strips against the form walls.

The next form and driver unit is then driven without fear of crushing the nearby form stayed by the buttress tool.

Plastic cement is poured into a form while the buttress tool is still in place so that no time is lost since the next pile form is driven at the same time. When driving is finished, the buttress tool is pulled and moved over
80 to the just driven form and set in it as soon as it is cleared of the driving unit J; the operation being repeated step by step along the row of pile forms, as planted.

In Fig. 17, a composite pile is shown as including a timber foot 70 with a reduced neck 71 bound by a bank 72, and having stay rods 73 on which is slidable a foot block 74 of an expanding jacket core unit 27. In this pile, the form walls 2 are turned in
85 at 2' to seat on a hemp rope packing ring 75 to prevent mud from entering around the foot of the form.

The rods 73 form a reinforce connecting the cast cement pile body to the timber. The cement body surrounds the reduced neck of the timber and a tight joint is made by the flattened hemp packer 75.

It will be apparent that by the present method and apparatus, the piles can be driven with their heads so close together as to form a continuous wall or foundation.

What is claimed is:

1. The pile planting method wherein: a hollow metal form is assembled on a driver and lowered into the ground, a jet of water is discharged from the foot of the assembly to cut a bore for the form as it is lowered, the driver is pulled from the planted form, a buttress is lowered to the form to sustain it from external pressure, a plastic cement is poured into the buttress while it is in place and the buttress is pulled before the cement sets.

2. The pile planting method consisting of cutting a hole by a jet of water and sinking a pile form in the hole by gravity and percussive blows to thrust aside obstacles not carried away by jet water, exhausting the residue water from the form, internally buttressing the form and running the cement into the form while the buttress is in place, and sinking another form adjacent to the first form while this is buttressed.

3. The pile planting method consisting of

cutting a hole by a jet of water and sinking a pile form in the hole by gravity and percussive blows to thrust aside obstacles not carried away by jet water, exhausting the residue water from the form, internally buttressing the form with a skeleton frame and running in cement while it is in place, and sinking another form adjacent to the first form while this is buttressed.

4. The pile planting method wherein: A hollow metal form is assembled on a driver and lowered into the ground, a jet of water is discharged from the foot of the assembly to cut a bore for the form as it is lowered, the driver is pulled from the planted form, a buttress is lowered to the form to sustain it from external pressure, a plastic cement is poured into the form while it is buttressed, the buttress being pulled out before the cement sets, and a pile form is sunk adjacent to the first form while it is buttressed.

5. Apparatus for constructing piles in place in earth formation, comprising a hollow form, means for internally bracing the form and for lowering it to grade, and means to hydraulically bore a hole as the form is lowered and ejecting means for discharging a gaseous fluid into said means to exhaust water from the form.

6. Apparatus for constructing piles in place in earth formation, comprising a hollow form, means for internally bracing the form and for lowering it to grade, means to hydraulically bore a hole as the form is lowered, and means for discharging a gaseous jet into the last named means to exhaust water from the planted form.

7. Apparatus for constructing piles in place in earth formation, comprising a hollow form, means for internally bracing the form and for lowering it to grade, means to hydraulically bore a hole as the form is lowered, ejector means to exhaust water from the planted form, said lowering means being extractable; and skeleton means for buttressing the planted form while it is being filled with cement and while another form is being driven nearby and which is adapted to be pulled before the cement fill sets.

8. Apparatus for constructing cement piles in place in earth formation, comprising a hollow form, and a lowering means removably fitting the form and bracing it internally, said means including a hydraulic jet device for discharging a water jet ahead of the foot of the form and provided near its foot with a gaseous ejector device for exhausting water.

9. Apparatus for constructing cement piles in place in earth formation, comprising a hollow form, and lowering means removably fitting the form and bracing it internally, said means including an expandible jacket and an expanding core therefore and hydraulic jet device for discharging a

water jet ahead of the foot of the form, and a hammer driven head structure on said jacket and core; said device including a hose connection on said core and passing through the shell.

10. Apparatus for constructing cement piles in place in earth formation, comprising a hollow form, lowering means removably fitting the form and bracing it internally, said means including a hydraulic jet device for discharging a water jet ahead of the foot of the form, and an ejector discharging into said means for exhausting water from the driven form.

11. Apparatus for constructing cement piles in place in earth formation comprising a lowering and driving device adapted for the external application of a complementary hollow pile form and including a removable hood, a hollow core box fixed to the hood to be raised and lowered therewith, an external, collapsible and expansible jacket structure whose upper portion is slidable in said hood, and means for expanding the jacket structure, as to the core, to facilitate extraction of the device from a form which is sunk thereby said box provided with a slidable foot ram having a check valve against back flow.

12. Apparatus for constructing cement piles in place in earth formation, comprising a lowering and driving device adapted for the external application of a complementary hollow pile form and including a hood, a hollow core box fixed to the hood to be raised and lowered therewith, an external, collapsible and expansible jacket structure whose upper portion is slidable in said hood, means for expanding the jacket structure, as to the core, to facilitate extraction of the device from a form which is sunk thereby; and a system of removable lift and lock bars connecting said box and its jacket.

13. Apparatus for constructing cement piles in place in earth formation, comprising a lowering and driving device adapted for the external application of a complementary hollow pile form and including a hood, a hollow core box fixed to the hood to be raised and lowered therewith, an external, collapsible and expansible jacket structure whose upper portion is slidable in said hood, and means for expanding the jacket structure, as to the core, to facilitate extraction of the device from a form which is sunk thereby; said hood having a system of hitch links and a removable lift bar connecting said jacket to said links, and a box bar engaged by the lift bar and locking the parts in position.

14. Apparatus for constructing cement piles in place in earth formation, comprising a lowering and driving device adapted for the external application of a comple-

mentary hollow pile form and including a hood, a hollow core box fixed to the hood to be raised and lowered therewith, an external, collapsible and expansible jacket structure whose upper portion is slidable in said hood, means for expanding the jacket structure, as to the core, to facilitate extraction of the device from a form which is sunk thereby, and lock means for detachably connecting said jacket structure to said hood to permit relative movement of the core and collapse of said jacket said hood having a set of hitch links connectible to said lock means to suspend the box and jacket.

15. In apparatus for placing piles, a driving core, a driving plate combined with said core, an unattached driving block removably mounted upon said plate, and pry means operatively mounted on the plate and operative to remove the applied driving block.

16. In apparatus for making cement piles in earth formation, a skeleton form buttress insertible into a planted form and expansible therein; said buttress providing for ready introduction of cement while in place in the form, means for collapsing the buttress and pulling it from the form before the cement has set.

ANTON E. MOE.

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