July 8, 1969 S. J. REHMAR 3,453,832

CAST-IN-PLACE CASINGS FOR CONCRETE PILES

Filed Jan. 10, 1967 Sheet 1 of 2

FIG. 1

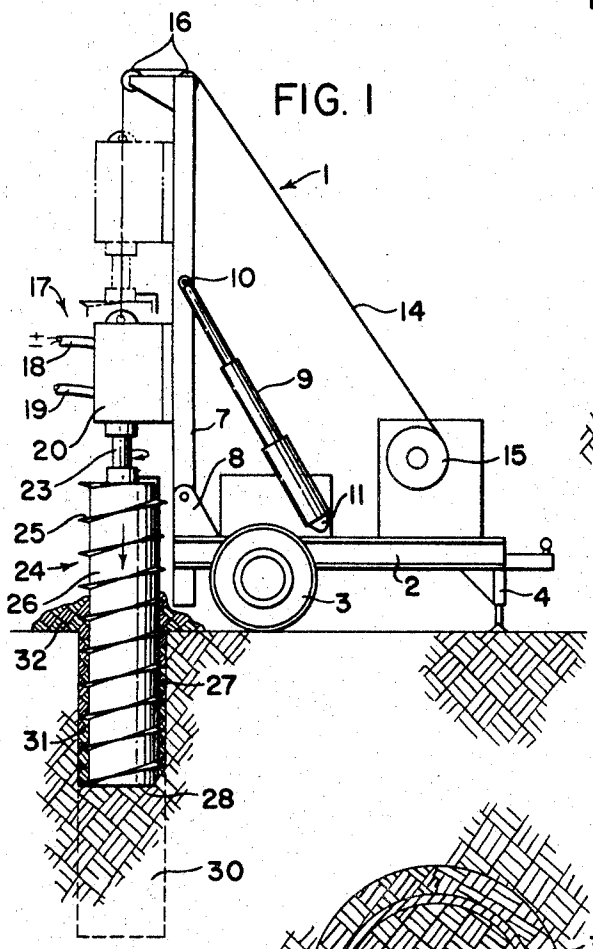
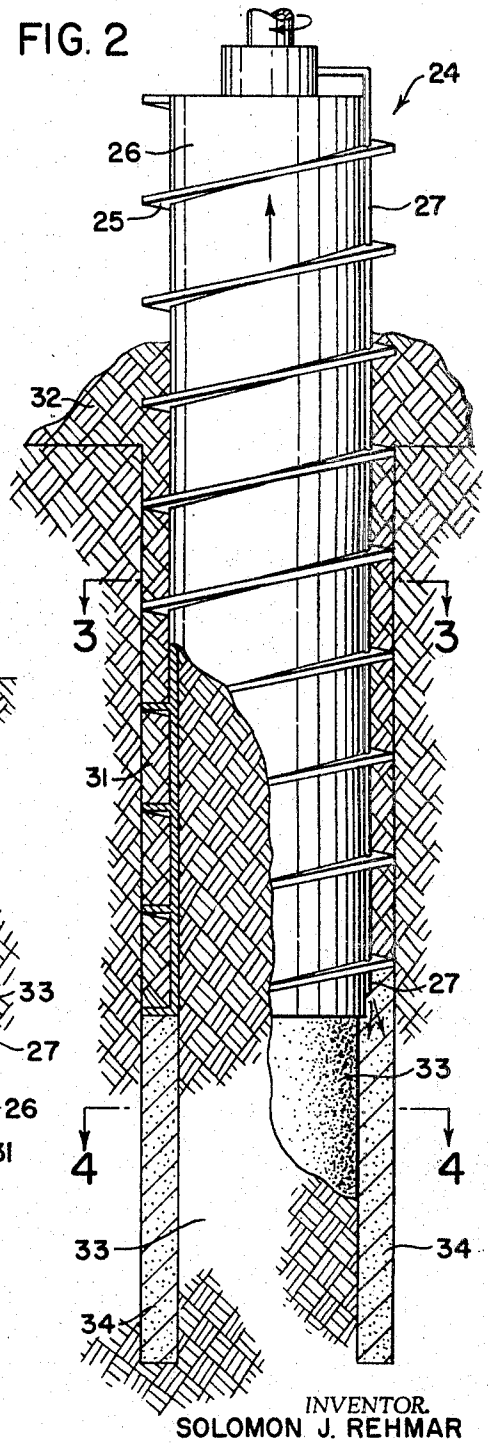


FIG. 2



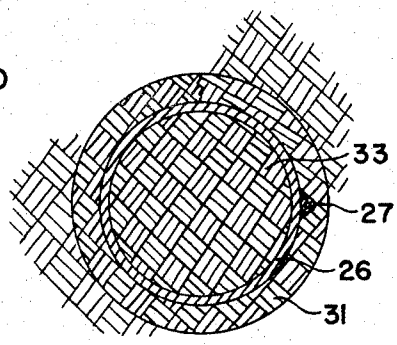


FIG. 3

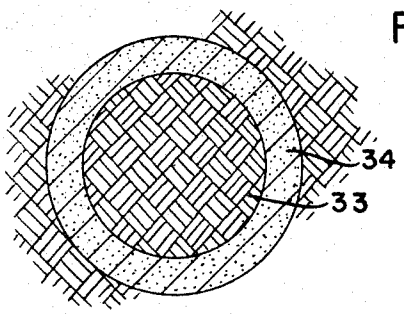


FIG. 4

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FIG. 5

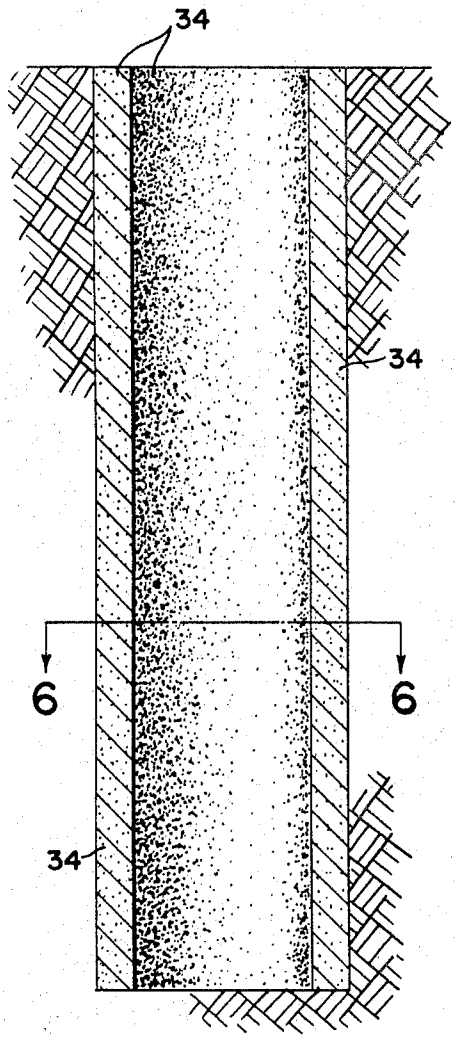
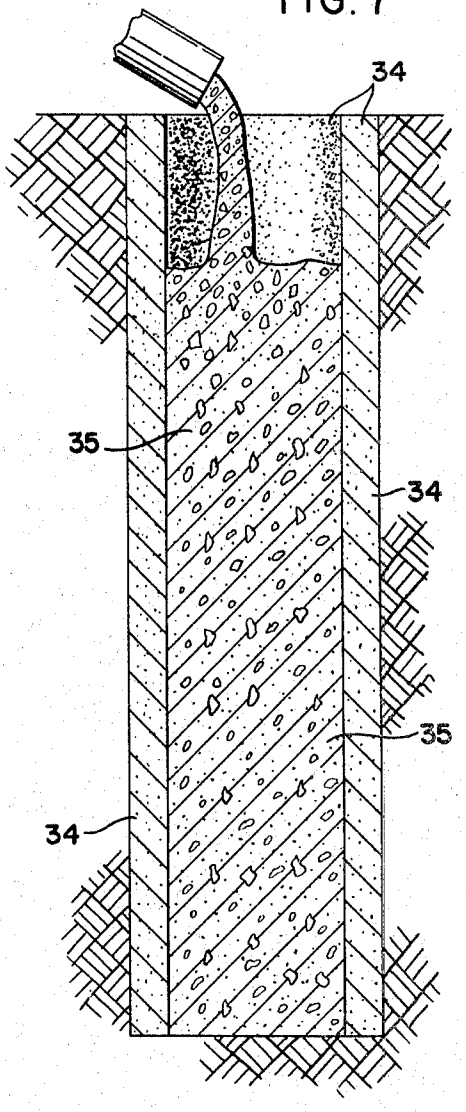


FIG. 7



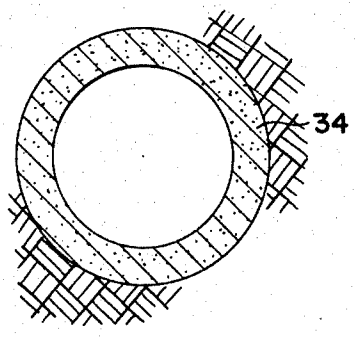


FIG. 6

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3,453,832
Patented July 8, 1969

3,453,832

CAST-IN-PLACE CASINGS FOR CONCRETE PILES

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Filed Jan. 10, 1967, Ser. No. 608,381
Int. Cl. E02d 5/34; E21c 13/04; E21b 3/02
U.S. Cl. 61—53.64 5 Claims

ABSTRACT OF THE DISCLOSURE

This application discloses an apparatus and method for forming cast-in-place casings for concrete piles. The apparatus is a drill having a hollow shaft with its lower end open at all times and a helical blade about it. A hollow pipe runs parallel to the hollow shaft for inserting grout along the outside of the shaft.

The process includes inserting the drill into the earth while leaving an earthen core in the shaft essentially untouched. Grout is ejected through the pipe as the auger is withdrawn thus forming a groute cylinder about the earthen core. After allowing the grout to dry, the core may be removed from the center of the grout casing and concrete may be placed in the grout casing.

Background of the invention

A large structure demands a solid foundation. When forming the foundation, the type of soil must be taken into consideration. If the soil is relatively firm, a hole may be drilled into the ground until a proper depth is reached and then withdrawn whereupon a foundation pile may be formed by simply placing concrete into the hole. Where the ground is softer and susceptible to caving in, a thin walled metal sleeve is usually placed into the hole after it is drilled to reinforce the walls. The concrete is subsequently poured into the sleeve. A disadvantage of this method is that the driving and withdrawing of a steel casing into the ground, may produce a vibration which can be transmitted to surrounding structures and therefore involves a substantial degree of risk of damage.

An alternate method of forming a pile in this type of soil, is to force an auger having a small closed hollow core into the ground and then as the auger is removed forcing concrete through the core. However, this process has inherent limitations because it is not able to be used for diameters much in excess of sixteen inches since the larger amounts of earth that must be moved require very large and expensive augering equipment. A typical apparatus and method are shown in Canadian Patent 670,042. It has the center closed during the boring operation so that an earthen core is not left in the hole upon termination of the operation.

British Patent 551,717 illustrates one method which deviates slightly from that normally used. A hollow casing having a spiral rib extending along its length and a shoe closing its lower end is pounded into the ground. A twisting motion is imparted to the casing because of the action of the rib as the casing moves into the earth. Concrete is then forced inside the casing and out of its lower end as it is withdrawn. During the withdrawal action, a grout mixture may be introduced between the outer casing wall and the hollow ribs.

It is obvious that the British Patent 551,717 could not be used in making larger diameter piles. The hollow casing is pounded with its end closed into the ground thus pushing the earth aside and compresses it as the casing travels downward. This process would be completely unworkable if the hollow casing had a large diameter. The amount of earth that would have to be moved would be so large that the system would require unnecessarily large, expensive and powerful equipment.

Patent 3,192,292 to Banks also relates to a method of forming hollow concrete casings. After a hole has been bored into the ground, a tapered core is inserted into the hole and centered on a plug. Grout or wet concrete is then poured into the hole between the wall and the core while the core is rotated until the grout or cement is set. Once the grout is set, the core is removed leaving a hollow concrete pile. This process is not to be used in the soft soils in which the present invention has its utility. The Banks patent requires that a hole be dug and then an artificial core placed therein. This necessarily means that the soil can support itself. Moreover, it is easily seen that this type of method requires extensive equipment and a vast number of steps to accomplish a similar result as that which is done much more simply in the instant invention.

The present invention is primarily directed to forming large diameter piles in relatively soft soil. For this reason the normal procedure of simply ejecting it through the hollow core of an auger drill is not possible, as explained above. This basic purpose also would eliminate any idea of simply pounding the casing into the ground because of the enormous mass of earth that would have to be compressed in moving such a large diameter casing into the ground.

Summary of the invention

The apparatus of this invention includes a drill having a hollow casing with its lower end perpetually open and with a helical blade about the casing. A pipe passes through the helical blades in a close relationship to the hollow casing and along its entire length. The hollow pipe has appropriate means for connecting it to a grout supply.

The process of forming the pile includes inserting the drill into the ground and injecting grout through the pipe as the auger is withdrawn from the earth while allowing an earthen core to remain within the grout. After allowing the grout to dry, the core may be removed from the center of the grout casing and concrete is placed therein.

FIG. 1 shows a drilling apparatus using the subject of this invention.

FIG. 2 indicates the withdrawal of the drill while injecting grout.

FIG. 3 is a sectional taken through **3**—**3** of FIG. 2.

FIG. 4 is a sectional taken through **4**—**4** of FIG. 2.

FIG. 5 shows the grout casing after a core of soil has been removed.

FIG. 6 is a sectional **6**—**6** of FIG. 5.

FIG. 7 shows concrete being poured into the grout casing.

A drilling apparatus **1** is mounted on a trailer **2** supported by wheels **3** and a support post **4**. A hinged mast **7** is rotatably mounted on a triangular support **8** in a generally vertical direction. Near its center the mast **7** is supported by a hydraulic mast raising cylinder **9** which is rotatably mounted to the mast **7** at **10** and to a support on the trailer **2** at connection **11**.

A cable **14** wound on a spool **15** on the trailer **2** extends upward and is supported on rollers **16** mounted on top of the mast **7**.

Suspended at one end of the cable **14** is a crown assembly **17** which includes a power input connection **18**, a grout inlet **19** and a motor **20**. The motor **20** is driven from a hydraulic or electrical supply (not shown) which is suitably attached to connection **18**. Extending from the motor **20** is a connecting shaft **23** which supports the drill indicated generally as **24**.

The drill **24** comprises helical wound flights of a blade **25** about a hollow shaft **26**. Extending out from the top of the drill **24** and down along its side parallel to but in close proximity thereof is a grout injection pipe **27**. The grout injection pipe usually passes through the helical flights **25**. The injection pipe **27** should be as close as possible to the hollow shaft **26** so that it does not unduly hinder the rotation of the drill **24**. The pipe **27** may also be formed integral with the shaft **26** or fit inside it as long as its lower end ejects the grout outside of the shaft **26**.

The lowermost end **28** of the drill **24** is open at all times and permits the soil to pass into the center section of the shaft **26** as it descends into the earth **30**.

In using the drilling apparatus **1**, the drill **24** is rotated in a clockwise manner as viewed from the top thus penetrating the earth **30**. As it descends downward, the helical flights **25** penetrate a cylindrically shaped section of the soil **31**. As it does so, it may simultaneously raise the soil **31** to the surface **32**.

After the drill **24** has descended to its maximum, it is then pulled upwardly either with or without rotation. As the drill moves upward, it moves the soil **31** to the surface **32** thus leaving an open space which is simultaneously filled with grout **34** from the pipe **27**.

It should be noted that as the drill **24** moves upwardly and the grout **34** forms a casing, a central core of earth **33** (best seen in FIGS. 2, 3 and 4) is maintained. Because this central core of earth is not in any way moved during the initial drilling and grout filling procedure, large machinery and power is not required to perform the operations in the instant invention.

The grout casing with the earth core may be used as a bearing surface for a structure. A solid earth column with a grout shell, is, in fact, a better bearing member than a solid grout column having the same cross sectional area as that of the shell. The shell with the earthen core is preferable to the solid member because of its lower length to cross-sectional diameter ratio.

If desired, the core of earth **33** may be removed by any conventional means such as forming a slurry and pumping it to the earth (FIGS. 5 and 6). The result is a grout casing having an empty center. The casing **34** extends upwardly in the formation of a cylinder. Once the earth **33** is removed, the center may then be filled with concrete **35** (FIG. 7).

It is also possible to excavate outside the grout casing in order to form an enlarged end bearing area.

For ease of description, the principles of the invention have been set forth in connection with but a single illustrated embodiment. It is not my intention that the illustrated embodiment nor the terminology employed in describing it be limiting inasmuch as variations in these may be made without departing from the spirit of the invention. Rather I desire to be restricted only by the scope of the appended claims.

I claim:

1. The method of forming cast-in-place casings for concrete piles comprising:

inserting a drill, having a hollow shaft with a helical blade about it and a hollow pipe running parallel to said hollow shaft, in the soil;

the lower end of said hollow shaft being open at all times and thereby forming a core of soil as said drill penetrates the soil;

withdrawing said hollow shaft;

injecting grout around said core of soil as said shaft is withdrawn.

2. The method of claim **1** wherein the core of earth from the center of the grout casing is removed; and concrete is placed into said grout casing.

3. The method of claim **2** wherein said drill is inserted into the earth by rotating it to a required depth.

4. The method of claim **3** wherein said core of soil is removed by forming a slurry and pumping it to the surface.

5. The method of claim **4** wherein said drill is rotated while it is withdrawn to bring loose soil to the surface and thereby make a space into which said grout may be injected.

References Cited

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JACOB SHAPIRO, *Primary Examiner.*

U.S. Cl. X.R.

61—41, 63; 175—171, 323, 394