July 13, 1965 V. J. FIORE 3,194,328

PILE DRIVING HAMMER AND BOULDER BREAKER, ROCK SEATING TOOL

Filed Oct. 15, 1962 3 Sheets-Sheet 1

FIG. 1

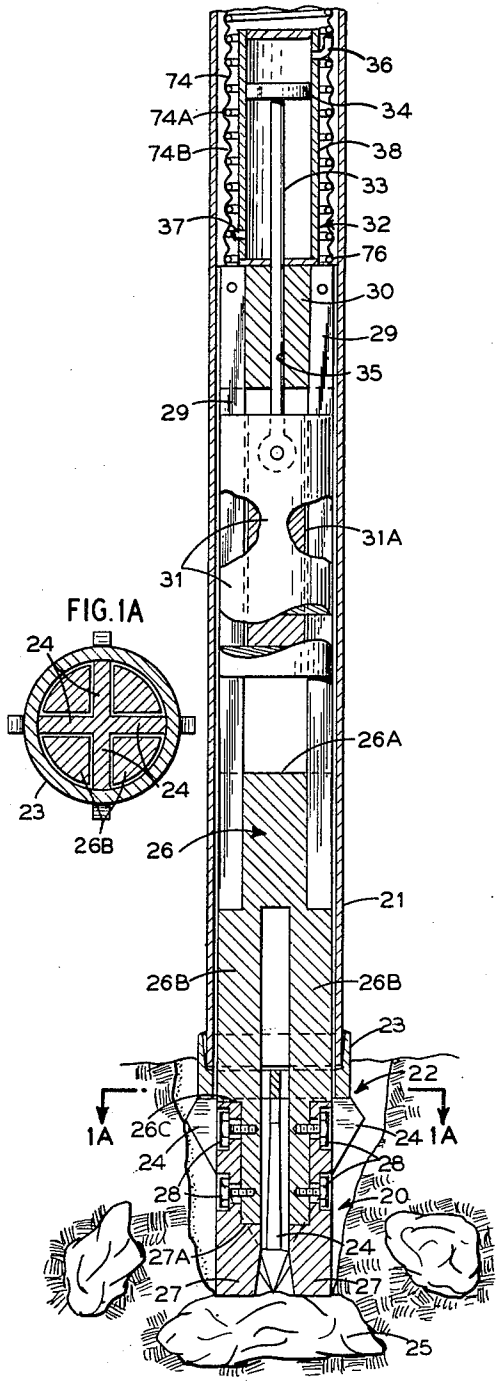
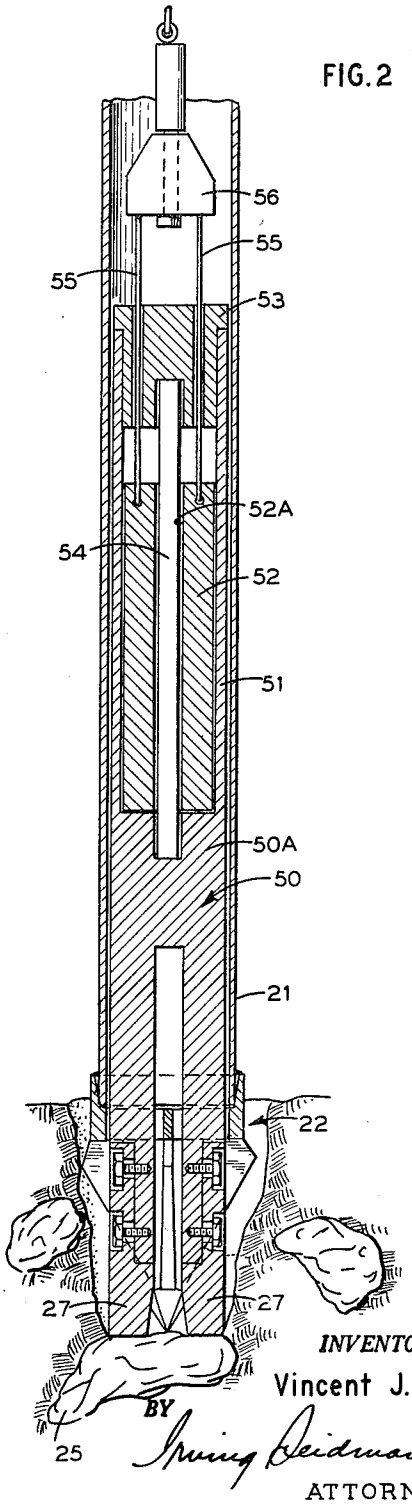


FIG. 1A

FIG. 2



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FIG. 3

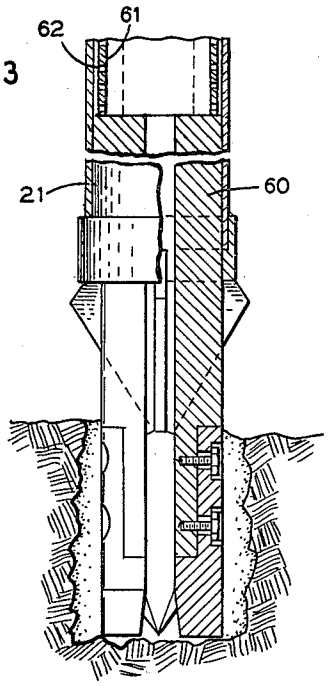


FIG. 4

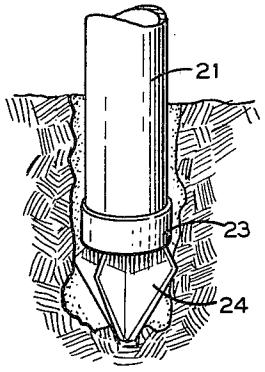


FIG. 13

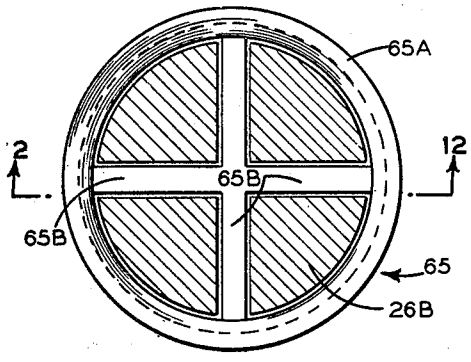


FIG. 12

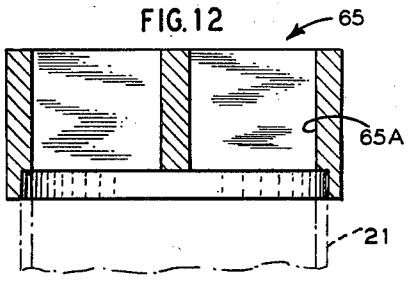
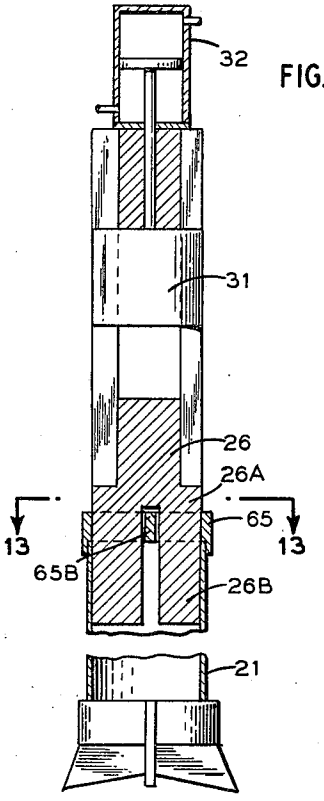


FIG. 11



PILE DRIVING HAMMER AND BOULDER BREAKER, ROCK SEATING TOOL

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FIG. 8

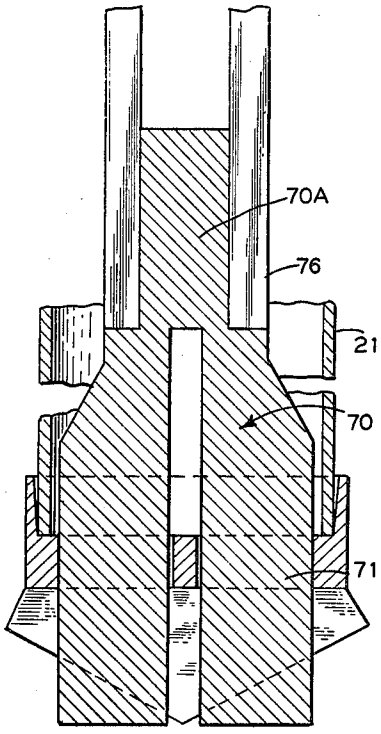


FIG. 9

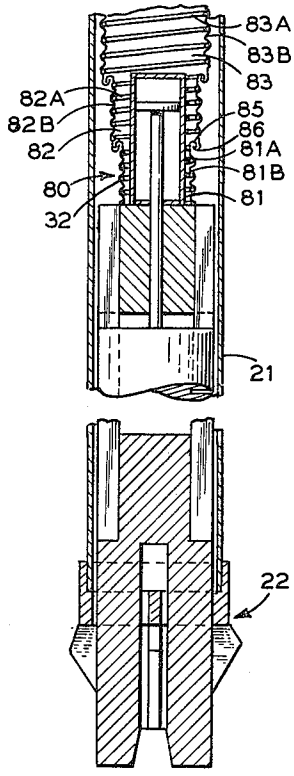


FIG. 5

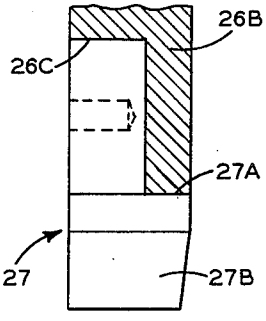


FIG. 7

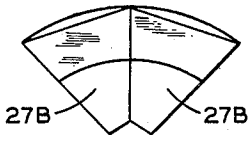


FIG. 6

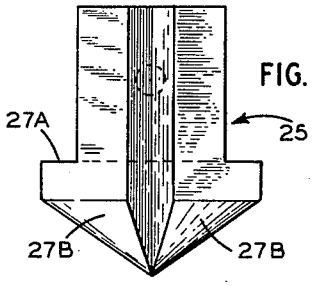
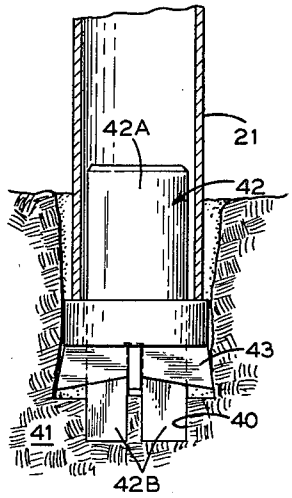


FIG. 10



United States Patent Office 3,194,328 Patented July 13, 1965

3,194,328

PILE DRIVING HAMMER AND BOULDER BREAKER, ROCK SEATING TOOL

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Filed Oct. 15, 1962, Ser. No. 230,367
18 Claims. (Cl. 175—92)

This invention relates in general to the pile driving art, and more specifically to a combination pile driving hammer and boulder breaker, rock seating tool adapted for driving and/or clearing away obstructions when driving open end piles having ram type driving tips or shoes.

In pile driving, although one of the oldest known operation in the field of building and construction and dating back to early time, it is still very difficult to estimate the cost for a particular job. Despite improvements over the years in rigging, pipe and driving equipment, and despite present day technology and ability to test said formation, it is still impossible to predict with any degree of certainty how long it will take to drive the necessary number of piles, or how many extra piles will have to be driven as a result of rejected piles. Rejections of piles occur by damage thereto either in driving or because of their failure to reach the required depth. Frequent causes of such rejections are due to boulders, old concrete and other obstructions which are encountered in the ground. Such obstructions are of particular hazard in the driving of open end piles.

Open end piles are generally used where the intention is to drive piles to rock and/or to boulder-gravel formations overlying rock. The difficulty in driving this type of pile is that on the way down to bedrock, layers of hardpan and/or boulders are frequently encountered which can result in severely damaging the pile especially when large boulders become wedged within the pile. Such boulders can tear the pile to shreds, oftentime causing the material of the pipe to enwrap the boulder so wedged, thus rendering chopping of the boulder virtually impossible.

To overcome some of the problems in driving such piles, resort has been made to the use of fin type and ramp type driving shoes, as disclosed in my joint U.S. Patent No. 2,874,547. However, while these driving shoes are able to do a thorough job, still to be considered is the pipe or pile section, which itself could be driven to destruction in the event such driving tip encountered any substantial resistance.

Therefore, an object of this invention is to provide a novel combination pile driving hammer and boulder breaker and rock seating tool which is particularly adapted for driving and/or clearing away obstructions encountered in driving open end piles.

Another object is to provide a tool which is adapted to cut a pocket in the bedrock in which the tip or shoe of the pile can be seated so as to prohibit lateral displacement thereof.

Another object is to provide a means for creating a pinned bond between the pile and bedrock to prevent bottom lateral slide.

Still another object is to provide a tool which can be readily adapted for driving a pile section.

The foregoing objects and other features and advantages are attained in accordance with this invention by a tool comprising an anvil which is adapted to be positioned within the pile being driven, and which anvil is provided with depending leg segments which are adapted to project beyond the openings defined by the fins or cross blade of a ram or fin type driving shoe connected to the end of an open pile section. Connected to the respective projecting leg segments is a cutting tool which may be detachably

connected thereto by a suitable fastening means. The arrangement is such that the leg segments are sized to hug the adjacent blades of the driving shoe with an allowable clearance therebetween for effecting relative movement therebetween. Means in the form of a driving hammer is provided for driving the anvil and connected cutting tool in advance of the pile driving shoe so that any obstruction encountered by the pile may be cleared away without subjecting the pile or pile section itself to forces which could cause the destruction thereof. Means are further provided for actuating the hammer means. Such means may be operated either by mechanical or fluid pressure, e.g. a piston and cylinder assembly, or by gravity. In one form of the invention disclosed, an extensible shielding means may be provided to protect the drive actuating means in the event a water condition is present. In addition the cutting tool may be either concurrently or alternately used for driving a pile section either from the top or at the bottom of the pile. If utilized to drive a pile from the top thereof, a special adaptor ring is provided for transmitting the impact force of the anvil to the pile shell.

A feature of this invention resides in the provision that the combination pile driving hammer and boulder breaker tool is relatively simple in construction, easy to use, and positive in operation.

Another feature resides in the provision that the tool is rendered versatile in that it may be utilized for either driving and/or clearing away obstacles ahead of the pile being driven.

Other features and advantages will become more readily apparent when considered in view of the drawings and specification in which:

FIG. 1 is a vertical sectional view of the hammering and boulder breaking tool of this invention, illustrated in operative boulder breaking position.

FIG. 1A is a sectional plan along line 1A—1A of FIG. 1.

FIG. 2 is a vertical sectional view which is similar to that of FIG. 1, but illustrating a slightly modified embodiment.

FIG. 3 is a fragmentary vertical section of another modification.

FIG. 4 illustrates a fragmentary perspective of the pile shown in place.

FIG. 5 is a detail side elevation view of the cutter tip.

FIG. 6 is a detail front view of the cutter tip.

FIG. 7 is a bottom view of the cutter tip.

FIG. 8 is a fragmentary vertical section view of another modified embodiment.

FIG. 9 is a vertical sectional view of still another embodiment.

FIG. 10 is a detail of a bonding pin utilized to anchor the pile in accordance with this invention

FIG. 11 illustrates the tool of this invention utilized as a pile driving means.

FIG. 12 is a detail section, taken along line 13—13 of FIG. 13, of a special adaptor for use with the tool when used as a pile driving means.

FIG. 13 is a plan view of FIG. 12.

Referring to the drawings, FIG. 1 illustrates the pile driving and boulder breaking, rock seating tool 20 of this invention. As shown the tool 20 is particularly adapted for use in driving an open end pile or pile section 21 which is fitted with a ram tip 22, e.g. of the type disclosed in my joint U.S. Patent 2,874,547. Such ram tips or drive shoes 22 generally comprise a ring 23 fitted to the bottom of the pile 21 and has connected thereto wedge-shaped blades 24 disposed at right angles to one another.

The tool 20 for clearing obstructions, e.g. a boulder 25, encountered by such piles comprises an anvil 26 having a body or head portion 26A which has integrally connected

thereto a plurality of depending leg segments 26B. In the illustrated embodiment four such leg segments 26B are utilized. Each of the leg segments 26B are adapted to project through the respective openings defined by adjacent fin blades 24. In accordance with this invention the leg segments 26B terminate in a cutting tip or edge 27. If desired the cuting tips 27 may be constructed so as to be detachably connected to the respective leg segments 26B. In the illustrated embodiment the respective leg segments 26B and associated cutting tip 27 are provided with cooperating shoulder portions 26C and 27A respectively, and suitable fastening means 28, e.g. a screw bolt, detachably connects the cutter tip 27 to the respective leg segments 26B. In this manner the cutting tips 27 can be readily detachable to facilitate sharpening. As shown, each leg segment 26B and associated cutting tip 27 is sized so as to closely hug the blades 24 with an allowable clearance to permit relative movement therebetween; and each cutting tip 27 is provided with inclined faces 27B to define a chiseled cuting edge.

Connected to the body portion 26A of the anvil 26, and extending upwardly therefrom, are a pair of guide bars 29 with a bumper head 30 connected to the upper end of the guide bar. Guided by the guide bars 29 for reciprocable movement between the anvil head 26 and the bumper head 30 is a driving hammer 31, the hammer 31 being provided with guide slots 31A for receiving the guide bars 29.

Connected to the bumper head 30 is a piston and cylinder assembly 32. As shown, the piston rod 33 of piston 34 extends through a bore 35 in the bumper head 30 and is connected at its end to the hammer means 31. It will be understood that the piston 34 may be either pneumatically or hydraulically operated with the fluid being introduced and discharged from the cylinder through conduits 36 and 37. Thus as the piston 34 is reciprocated within the cylinder 38 the hammer 31 connected to the piston rod 33 will rise and fall accordingly. In doing so, the anvil 26 and cutting leg segment 26B connected thereto can be driven in advance of the pile driving tip 22.

In operation, the open end pile 21 may be driven into the ground by conventional driving means. In the event an obstruction is encountered, e.g. a boulder 25, the boulder breaking tool 20 is actuated by energizing the piston and cylinder assembly 32. The actuation of the piston 34 causes the hammer 31 to apply an impact blow on the anvil 26 causing the cutter legs 27 thereof to break up boulder 25. It is to be appreciated that when the boulder breaker tool 20 is in operation the forces produced thereby to break up the obstructions are not transmitted to the pile shell 21. Thus the probability of driving the shell 21 to destruction is elimiated with the instant tool. For this reason the rejection of piles due to obstructions encountered in driving the same can be greatly minimized. It will be noted that the leg segments 26B hug the area of the cross blades 24 so that regardless of the shape of the rock or boulder encountered, the cutters 27 independently of each other will strike effectively. The cutting tool 20 may be operated until the leg cutters 27 penetrate the ground or obstruction its full length. It will be noted that the length of the cutter legs 26B is such that the ground in advance of the pile is sufficiently prepared so that the pile may be driven with only ordinary applied forces.

If desired, when the pile 21 is driven to bedrock, the cutting tool 20 of this invention may be employed to drill a hole 40 in the bedrock 41, and the pile 21 anchored in place by a pin 42, as illustrated in FIG. 10. The use of such pins 42 prohibit lateral displacement of the pile 21. The pin construction comprises essentially a head portion 42A sized to be received within the pile shell 21, and had integrally connected therewith depending leg portions 42B which extend through the open end of the fin type driving shoe 43.

The modification of FIG. 2 is similar to that of FIG. 1, except that the anvil 50 is provided with an integrally connected imperforate tubular casing 51 extending upwardly from the head portion 50A thereof to enclose the hammer means 52. A bumper head 53 forms a closure for the upper end of the tubular casing 51. Extended between the anvil head 50A and the bumper head 53 and through a bore 52A in the hammer 52 is a guide rod 54 for guiding the rise and fall of the hammer means therein.

In this form of the invention the hammer means 52 is connected to driving leads 55 which connect to a yoke 56 which in turn is connected to a piston and cylinder assembly (not shown) located on the driving rig (not shown). In operation, this form of the invention is similar to that of FIG. 1, hereinbefore described.

The embodiment of FIG. 3 is identical to that of FIG. 2 with the exception that the tubular extension 61 of the anvil 60 is provided with a plurality of perforations 62. Such construction is desirable in the event water is encountered in the driving operation.

If desired the boulder breaker tool (herein described) may be alternately used for driving a pile section 21. To convert the tool 20 to function as a pile driver only, an adaptor 65, as illustrated in FIGS. 11 to 13, is required. The adaptor 65 comprises a ring 65A which is adapted to be fitted to the upper end of the pile section 21 which is to be driven. Integrally connected with the ring 65A are a pair of cross-bars 65B. The arrangement is such that the leg segments 26B of the anvil 26 can be inserted through the openings of the adaptor 65 so that anvil head 26A may rest on cross-bars 65B, as shown in FIG. 11. Thus upon actuation of the hammer 31 by a piston assembly 32 or conventional driving leads, the tool 20 serves as a pile driver for sinking the shell 21 into the ground. Should an obstruction be encountered, the adaptor ring 65 may be removed, and the tool 20 dropped into position within the shell 21 into rock breaking position, as shown for example in FIG. 1.

FIG. 8 illustrates a further modification of the invention. In this form of the invention the anvil 70 is provided with relatively larger leg segments 71 which can be welded or otherwise secured to the anvil head 70A. The anvil head 70A in turn may be formed to cooperate with any of the hammer and guide arrangements hereinbefore described. In this form of the invention the anvil and hammer assembly may be utilized with a number of leg sets of variable size, depending on the diameter of the pile to be driven. In this manner a single sized anvil head and hammer assembly may be interchangeably used with a number of different size leg sets.

In order to protect the piston and cylinder assembly 32 when such drive means are directly connected to the bumper head 30, in the event water is present, an expandible shield 74 may be provided to enclose the piston and cylinder assembly 32. As seen in FIG. 1, this shield 74 may comprise a spring 74A enclosed by a flexible waterproof covering 74B which may be of canvas, rubber or like material. One end 76 of the shield is connected to the bumper head 30 to enclose the piston and cylinder assembly 32. Thus as the cutting tool 20 is driven the shield 74 is free to expand with the downward movement of the tool. Therefore, the piston assembly 32 is protected from water damage, if water is present.

FIG. 9 illustrates a modified telescoping type of shield 80. This embodiment comprises a plurality of expandible shield sections 81, 82, 83, which are adapted to nest within one another. Each section may be formed of a coil spring 81A, 82A, 83A, respectively, enclosed in a flexible covering 81B, 82B, 83B. Adjacent sections are provided with cooperating coupling members 85 and 86 to define a slip-joint therebetween. The arrangement is such that as the innermost section 81 has been expanded to its maximum extent, the next succeeding section 82 coupled thereto begins to extend, and each succeeding section fol-

lowing in order until the shield 80 has extended its full distance.

From the foregoing, it will be apparent that the tool can be readily operated to function as a boulder breaker and rock seating tool, or alternately as a pile driver. It is relatively simple, and easy to use. Yet it is highly effective for minimizing the rejection of pile due to destruction of the shell as a result of encountering obstructions or in failing to reach desired depth.

While the instant invention has been disclosed with reference to a particular embodiment thereof, it is to be appreciated that the invention is not to be taken as limited to all of the details thereof as modifications and variations thereof may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. Means for use in driving open end piles comprising an anvil adapted to be disposed within the shell of the pile to be driven, said anvil having a plurality of cutting legs adapted to project beyond the open end of the shell, vertical guide means connected to said anvil, a bumper connected to the upper end of said guide means, a hammer guided by said guide means for vertical movement between said anvil and said bumper head to impart a driving impact to said anvil, and means connected to said hammer to effect the raising and lowering thereof for driving said anvil.

2. Means for clearing away obstructions encountered in driving open end piles comprising an anvil adapted to be disposed within the shell of the pile to be driven, said anvil having a plurality of cutting legs adapted to project beyond the open end of the shell, vertical guide means connected to said anvil, a bumper connected to the upper end of said guide means, a hammer guided by said guide means for vertical movement between said anvil and said bumper head to impart a driving impact to said anvil, and means connected to said hammer to effect the raising and lowering thereof for driving said anvil, said latter means including a piston and cylinder assembly for effecting the operation of said hammer when an obstruction is encountered.

3. A cutting tool for cutting away rock, boulders and other obstructions encountered in driving open end piles fitted with fin type driving tip, said tool comprising an anvil having a plurality of depending leg segments, said leg segments being arranged to pass through the openings in said tip with an allowable clearance between the respective leg segments and the fins of said tip, said leg segments terminating in a cutting edge, a hammer for driving said anvil when said tip is confronted with an obstruction, means for imparting a reciprocating movement to said hammer for driving said anvil to clear said obstruction, and means connected to said anvil for guiding the movement of said hammer during a hammering operation thereof.

4. A cutting tool for use in open end piles fitted with an open end driving shoe defined as a ring collar formed integrally with a plurality of angularly disposed fin type blades, said tool comprising

(a) an anvil having a plurality of depending leg segments arranged to pass through the opening defined between adjacent blades of said shoe,

(b) each of said leg segmentss being sized for hugging the adjacent blades with an allowable clearance for effecting relative movement therebetween,

(c) a cutting tip removably connected to the end of each of said leg segments,

(d) a hammer means arranged to apply a driving force on said anvil for driving the same to clear away any obstruction encountered by said pile during the driving thereof,

(e) guide means connected to said anvil for guiding said hammer,

(f) and means for imparting a reciprocal movement

to said hammer for applying the hammering force whereby said hammering force is applied in clearing away the obstruction and is applied primarily to the anvil thereby preventing the pile shell from being driven to destruction.

5. A cutting tool for use in open end piles fitted with an open end driving shoe defined as a ring collar formed integrally with a plurality of angularly disposed fin type blades, said tool comprising

(a) an anvil having a plurality of depending leg segments arranged to pass through the opening defined between adjacent blades of said shoe,

(b) each of said leg segments being sized for hugging the adjacent blades with an allowable clearance for effecting relative movement therebetween,

(c) a cutting tip removably connected to the end of each of said leg segments,

(d) a hammer means arranged to apply a driving force on said anvil for driving the same to clear away any obstruction encountered by said pile during the driving thereof,

(e) guide means connected to said anvil for guiding said hammer,

(f) and means for imparting a reciprocal movement to said hammer for applying the hammering force to the anvil only when an obstruction is encountered,

(g) said latter means comprising a piston and cylinder assembly operatively connected to said hammer means to effect operation thereof.

6. A driving and cutting tool adapted for use in open end piles having secured thereto an open end driving shoe formed as a ring collar with integrally connected fin type crossblades, said tool comprising

(a) an anvil having a body portion and a plurality of depending leg segments connected thereto, each of said leg segments being arranged to pass through an opening in the end of the pile between adjacent blades,

(b) each of said leg segments being sized for hugging the adjacent blades with an allowable clearance for effecting relative movement therebetween,

(c) a cutting tip connected to the end of each of said leg segments,

(d) each of said leg segments and connected cutting tips have cooperating abutting shoulder portions,

(e) a fastening means for detachably connecting each of said cutting tips to its respective leg segment,

(f) an elongated guide means connected to the body portion of said anvil and arranged to extend upwardly therefrom,

(g) a hammer means mounted for reciprocal movement on said guide means,

(h) a bumper head connected to the upper end of said guide means,

(i) driving means disposed above said bumper head for effecting a reciprocating movement of said hammer means so as to impart a driving force to said anvil and connected cutter leg segments for clearing away any obstructions encountered by said pile,

(j) and said anvil being adapted for driving the pile when said obstructions have been cleared due to the impact action of said body on the fin blades of said shoe.

7. The invention as defined in claim 6 wherein said driving means comprises

(a) a piston and cylinder assembly connected to said bumper,

(b) said assembly including a piston rod connected to said hammer means, and

(c) means for introducing a fluid pressure into said assembly to effect actuation of the piston of said assembly.

8. The invention as defined in claim 6 wherein said driving means comprises

(a) driving leads connected to said hammer means,

(b) said leads being adapted to be operated by a driving rig.

9. A driving and cutting tool adapted for use in open end piles fitted with an open end driving shoe formed as a ring collar with integrally connected fin type cross-blades, said tool comprising

(a) an anvil having a body portion and a plurality of depending leg segments connected thereto, each of said leg segments being arranged to pass through an opening in the end of the pile between adjacent blades,

(b) each of said leg segments being sized for hugging the adjacent blades with an allowable clearance for effecting relative movement therebetween,

(c) a cutting tip connected to the end of each of said leg segments,

(d) a fastening means for detachably connecting each of said cutting tips to its respective leg segments,

(e) a hammer means,

(f) means for encasing said hammer means within said pile,

(g) said encasing means comprising an elongated tubular extension integrally connected to the body portion of said anvil to form a housing of said hammer means,

(h) said bumper head being connected to the upper end of said housing,

(i) a guide rod connected between said bumper head and anvil for guiding therebetween the rise and fall of said hammer means, and means for driving said hammer means.

10. The invention as defined in claim 9 wherein said tubular extension is imperforate.

11. The invention as defined in claim 9 wherein said tubular extension is perforated.

12. A cutting tool for use in open end piles fitted with an open end driving shoe defined as a ring collar formed integrally with a plurality of angularly disposed fin type blades, said tool comprising

(a) an anvil having a plurality of depending leg segments arranged to pass through the opening defined between adjacent blades of said shoe,

(b) each of said leg segments being sized for hugging the adjacent blades with an allowable clearance for effecting relative movement therebetween,

(c) a cutting tip removably connected to the end of each of said leg segments,

(d) a hammer means arranged to apply a driving force on said anvil for driving the same to clear away any obstruction encountered by said pile during the driving thereof,

(e) guide means connected to said anvil for guiding said hammer,

(f) means for imparting a reciprocal movement to said hammer for applying the hammering force,

(g) said latter means including a piston and cylinder assembly operatively associated with said hammer means for actuating the same, and

(h) a shielding means for enclosing said piston and cylinder means to protect the same against water damage in the event water is present.

13. The invention as defined in claim 12 wherein

(a) said shielding means is rendered expandible as said tool is driving,

(b) said shielding means including a coil spring, and

(c) a covering of flexible material enclosing said spring.

14. A driving and cutting tool adapted for use in open end piles fitted with an open end driving shoe formed as a ring collar with integrally connected angularly disposed fin type cross-blades, said tool comprising,

(a) an anvil having a body portion and a plurality of depending leg segments connected thereto, each of said leg segments being arranged to pass through an opening in the end of the pile between adjacent blades,

(b) each of said leg segments being sized for hugging the adjacent blades with an allowable clearance for effecting relative movement therebetween,

(c) a cutting tip connected to the end of each of said leg segments,

(d) each of said leg segments and connected cutting tips have cooperating abutting shoulder portions,

(e) a fastening means for detachably connecting each of said cutting tips to its respective leg segment,

(f) an elongated guide means connected to the body portion of said anvil and arranged to extend upwardly therefrom,

(g) a hammer means mounted for reciprocal movement on said guide means,

(h) a bumper head connected to the upper end of said guide means,

(i) a piston and cylinder assembly disposed above said bumper head for effecting a reciprocating movement of said hammer means so as to impart a driving force to said anvil and connected cutter leg segments for clearing away any obstructions encountered by said pile,

(j) and shield means for enclosing said piston and cylinder assembly to protect the same from water damage.

15. The invention as defined in claim 14 wherein said shielding means includes:

(a) a coil spring connected to said bumper head, and

(b) a cover of flexible material enclosing said spring.

16. Means for driving open end piles comprising an adaptor ring having cross bar integrally connected thereto fitted to the upper end of the pile, an anvil, said anvil having a plurality of depending legs adapted to project through the openings in said adaptor, vertical guide means connected to said anvil, a bumper connected to the upper end of said guide means, a hammer guided by said guide means for vertical movement between said anvil and said bumper head to impart a driving impact to said anvil, and means connected to said hammer to effect the raising and lowering thereof for applying a driving force to said anvil for sinking said pile.

17. A driving and cutting tool adapted for use in open end piles fitted with an open end driving shoe formed as a ring collar with integrally connected angularly disposed fin type cross blades, said tool comprising,

(a) an anvil having a body portion and a plurality of depending leg segments connected thereto, each of said leg segments having a cutting tip arranged to pass through an opening in the end of the pile between adjacent blades,

(b) each of said leg segments being sized for hugging the adjacent blades with an allowable clearance for effecting relative movement therebetween,

(c) an elongated guide means connected to the body portion of said anvil and arranged to extend upwardly therefrom,

(d) a hammer means mounted for reciprocal movement on said guide means,

(e) a bumper head connected to the upper end of said guide means,

(f) a piston and cylinder assembly disposed above said bumper head for effecting a reciprocating movement of said hammer means so as to impart a driving force to said anvil and connected cutter leg segments for clearing away any obstructions encountered by said pile,

(g) and shield means for enclosing said piston and cylinder assembly to protect the same from water damage wherein said shielding means include a plurality of nested sections which are adapted to telescope between inoperative nested position and operative extended position.

18. In combination, an open end pile comprising a shell fitted with a fin type driving shoe and an anchoring pin located in the bottom of said shell for pinning the pile to rock so as to prohibit lateral displacement of said pile, said pin comprising a head portion and a plurality of depending leg portions, said leg portions being adapted to extend beyond the end of the pile and into a hole drilled into said rock.

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