

[54] **PILE STRUCTURE**

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[51] Int. Cl. **E02d 5/62**

[58] Field of Search 61/53.58, 53.74, 53, 53.64,
61/53, 66, 63, 53.52, 40, 41

[56] **References Cited**

UNITED STATES PATENTS

1,905,643	4/1933	Johnson	61/53.74 X
3,206,935	9/1965	Phares	61/53.52
3,540,225	11/1970	Muller	61/53.52
3,638,433	2/1972	Sherard	61/53.52
3,815,374	6/1974	Hogan	61/53.74 X

FOREIGN PATENTS OR APPLICATIONS

641,729	5/1962	Canada	61/53.58
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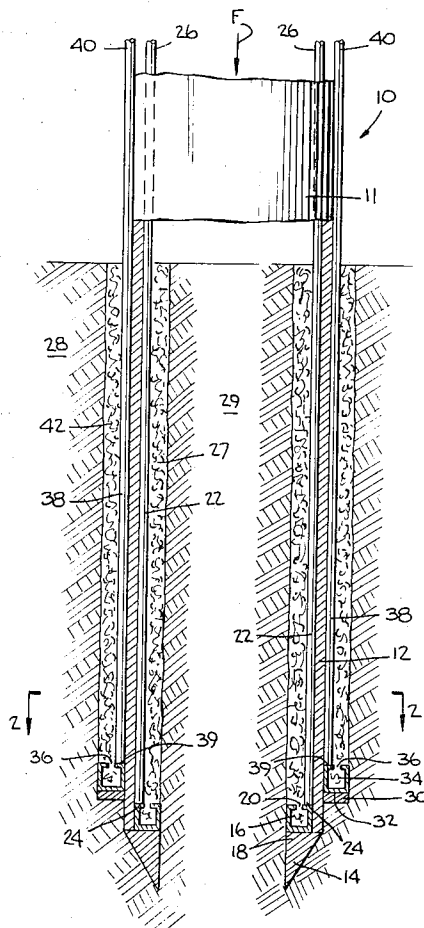
Primary Examiner—Jacob Shapiro

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[57] **ABSTRACT**

This invention relates to a pile structure and the method of forming a pile structure in situ which includes a pile having an annularly shaped band portion mounted adjacent the lower end thereof that supports an annular manifold on its upper surface, the manifold having a plurality of spaced upwardly directed nozzles. Grout tubes extend from near the top end of the pile downwardly adjacent the pile walls to the manifold. When the pile is driven into the earth, grout is simultaneously forced through the grout tubes into the manifold and upwardly out through the plurality of nozzles to completely fill the annular space between the walls of the pile and the adjacent earth. Upon completion of the driving operation, the flow of grout is terminated and the grout is allowed to set-up and form a bonded interface between the pile and the adjacent earth.

17 Claims, 5 Drawing Figures



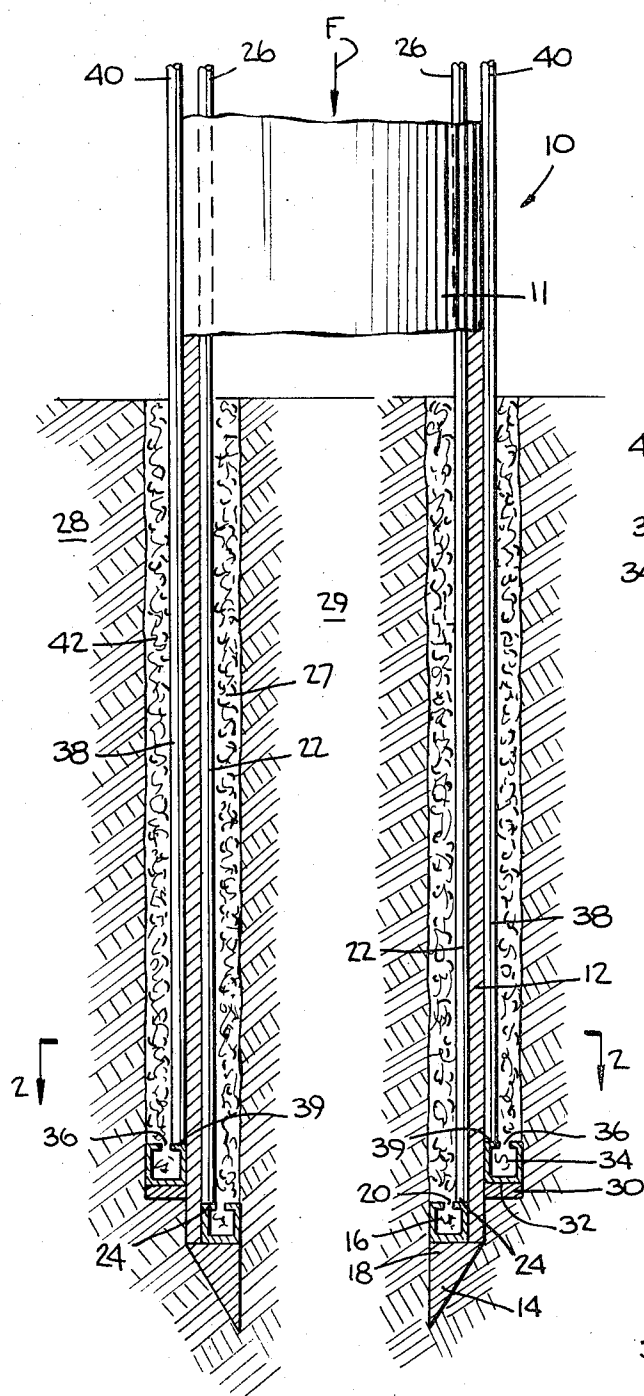


Fig. 1.

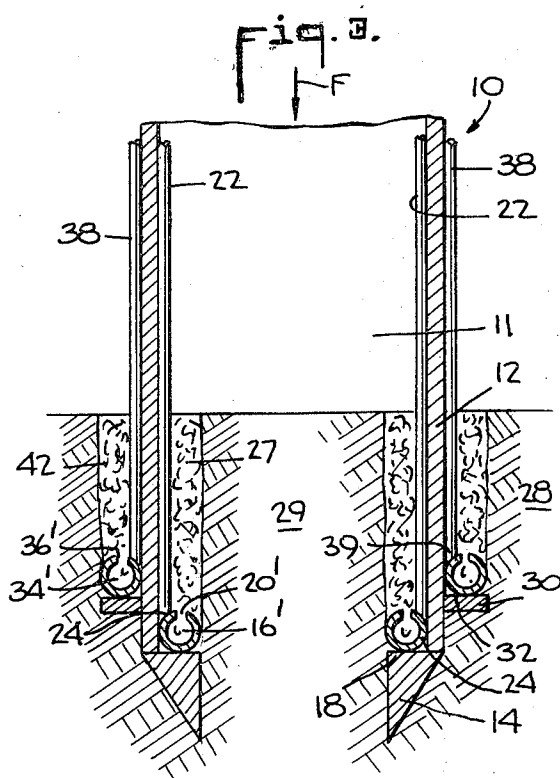
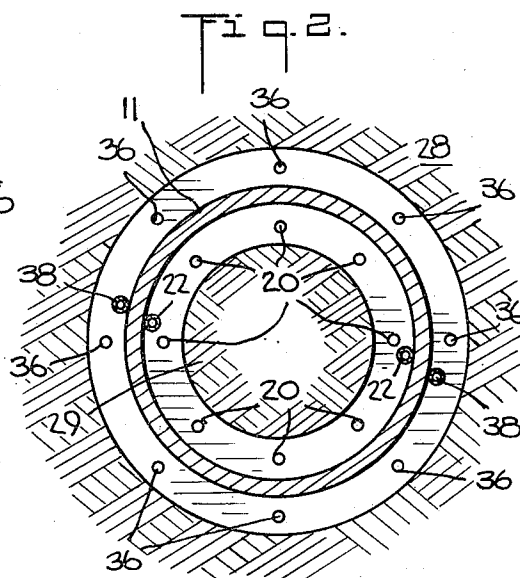
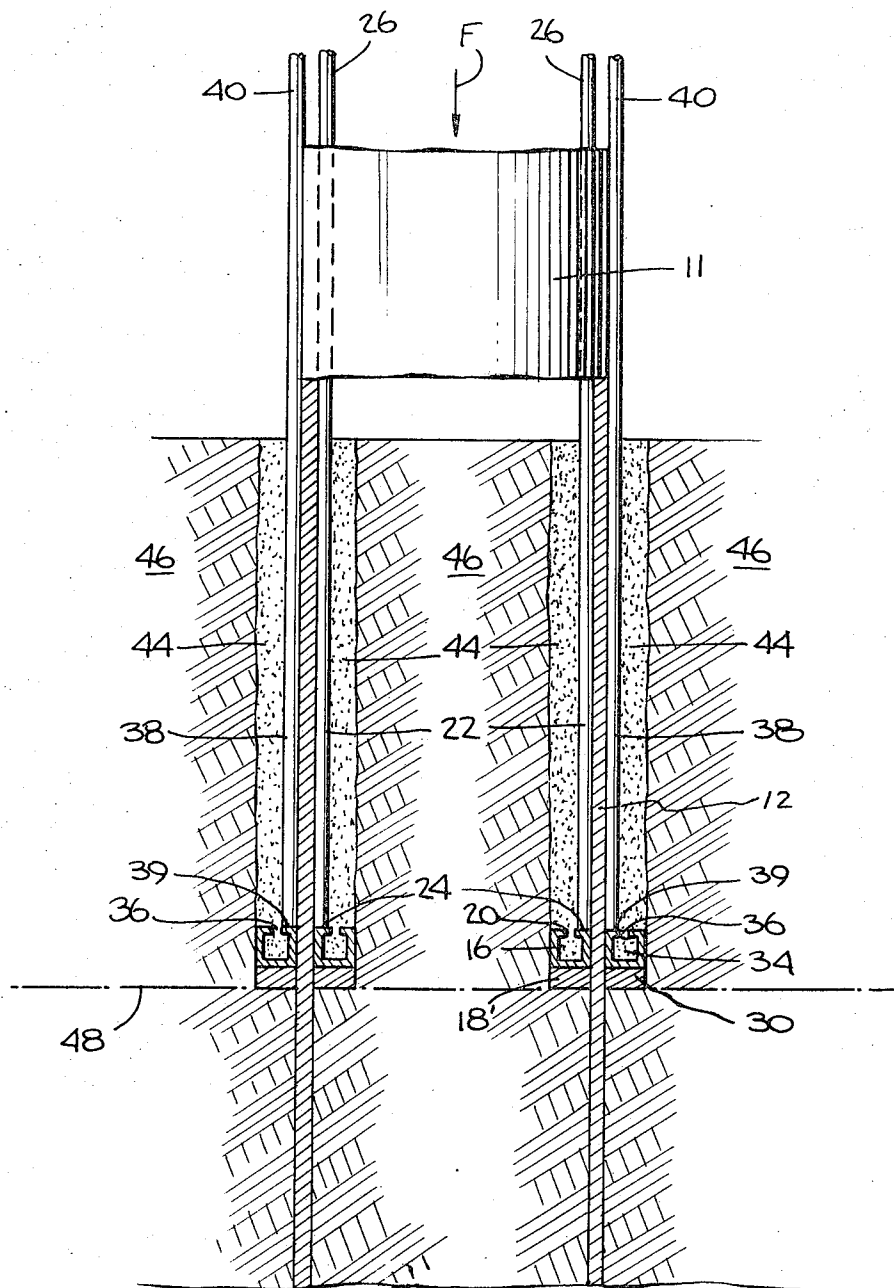


Fig. 2.



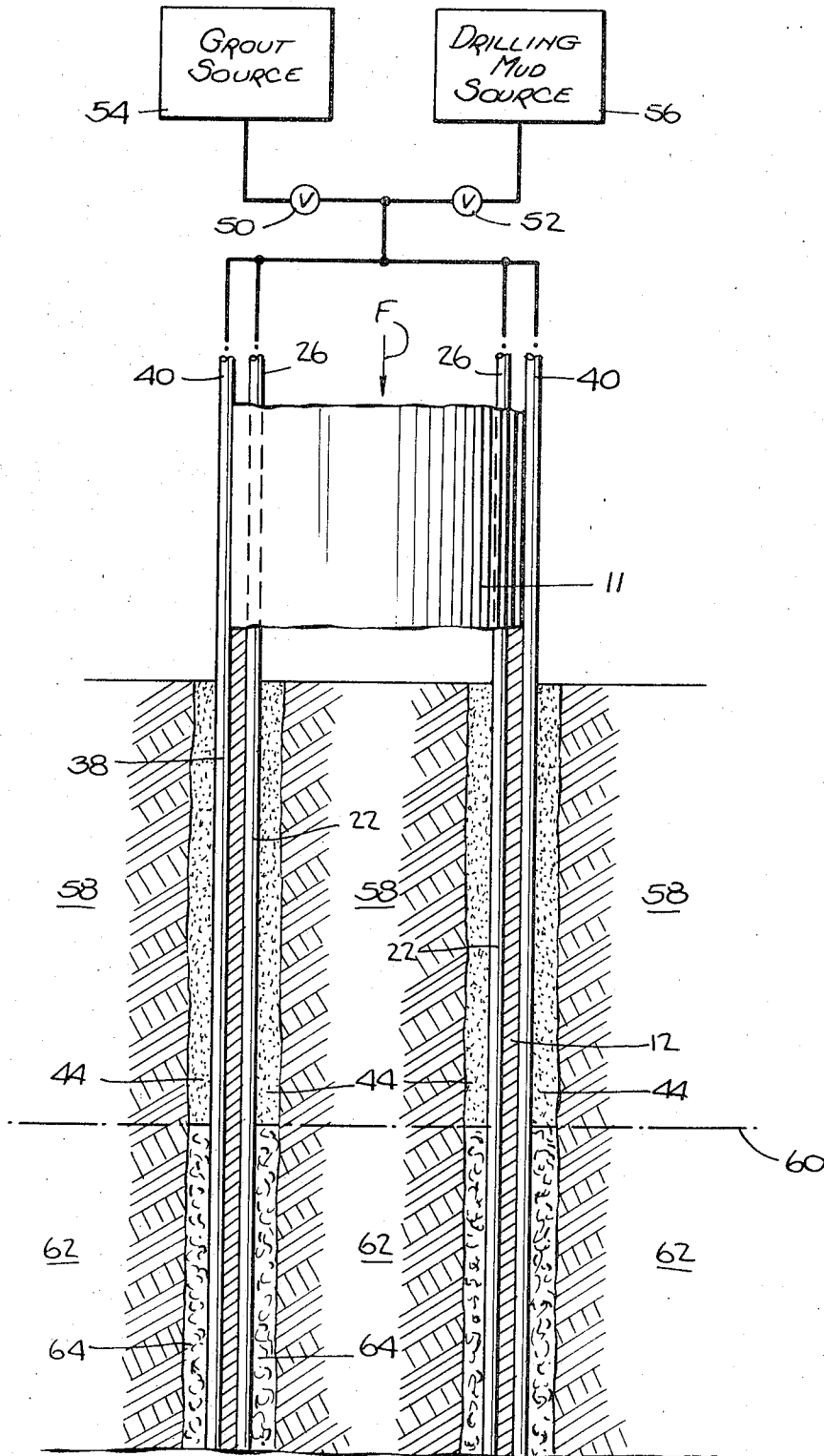


Fig. 5.

PILE STRUCTURE

This invention relates to a pile structure and to a method of forming a pile structure in situ. In certain types of sand, a driven pile does not develop very much friction between the outer wall of the pile and the surrounding earth. Particular difficulty is experienced due to lack of friction in partially cemented sand that appears to be made up of skeletal remains of organisms and other materials. In an undisturbed state these sands do have some compressive strength, but when a pile is driven into them they appear to be shattered with the result that the pile obtains very little side friction from the material after passing through it. When such soil conditions exist, difficulty is encountered in installing, for example, a drilling platform wherein the structure is to be carried on piling supports. Heretofore, attempts were made to overcome this problem by predrilling a hole at the pile location to the required depth. The predrilling consisted of carrying a pipe pile down into the hole just behind an oversized drilling bit, and the cuttings were removed by the drilling operation. When the drilled hole had reached the desired depth, a grouting operation was commenced which filled the annular space between the outside of the pile and the surrounding earth with cement grout that set-up or hardened and resulted in a bond between the earth and the grout and between the grout and the pile, thereby allowing the pile to carry the required load which was either an uplift or a downthrust load.

Another prior art method consisted in driving a tubular shaft with an enlarged foot into the ground to form an annular cavity about the shaft during the driving operation, and gradually lowering the feed pipe into the cavity as it was formed, to thereby fill the cavity with cementitious material. Thereafter, the shaft was withdrawn while the interior thereof was filled with a filler material to form an inner core. Related patents in this art include U.S. Pat. No. 3,512,365 issued May 19, 1970; U.S. Pat. No. 2,923,133 issued Feb. 2, 1960; U.S. Pat. No. 2,673,453 issued Mar. 30, 1954.

The present invention is intended to provide improvements upon the method and the piles formed according to prior art techniques. According to one exemplification of the invention, I provide a pile formation characterized by a pile having annular shaped band means mounted adjacent the lower end thereof extending radially from the wall of the pile. Annular manifold means is mounted on the upper surface of the band means and is provided with a plurality of spaced upwardly directed nozzles. The manifold means is provided with inlets for receiving grout tubes extending from near the top end of the pile. A cement grout bonded interface is interposed between the pile and the adjacent earth. In one form of the invention the pile is of tubular configuration and the band means extends radially inwardly and radially outwardly from the walls of the pile. The manifold means are disposed on the upper surface of the band means on the inside and on the outside of the walls of the pile, and the grout tubes extend to the manifold means on the inside and on the outside of the walls of the pile. A cement grout bonded interface is interposed between the pile and the earth plug inside the pile, as well as between the pile and the surrounding earth. According to one aspect of the invention, the band means and manifold means are disposed only on the outside of the pile and the cement

grout bonded interface is interposed only between the pile and the surrounding earth, while according to another aspect of the invention the band means and manifold means are located only on the inside of the pile and the cement grout bonded interface is interposed only between the pile and the earth plug inside the pile.

According to another form of my invention, I provide a new and improved method of forming piles in situ which is characterized by the steps of driving a pile into the earth while simultaneously forcing grout down through grout tubes into manifold means located on the upper surface of band means mounted adjacent the lower end of the pile, and passing said grout upwardly out through a plurality of nozzles located in the upper surface of the manifold to completely fill the annular space between the walls of the pile and the adjacent earth. Upon completion of the driving of the pile to its desired depth in the earth, the flow of grout is terminated and the grout is allowed to set-up and form a bonded interface between the pile and the adjacent earth.

In still another form of my invention, I provide a method of forming a pile structure in situ in earth having a so-called "negative friction." That is, the earth characteristics are such that at particular elevations settlement or consolidation of the material around the pile causes overloading of the pile, thereby resulting in structure settlement. The pile structure includes a pile, an annularly shaped band portion mounted around the periphery of the pile at a location corresponding to the particular elevation having negative friction, an annular manifold having a plurality of upwardly directed nozzles mounted on the upper surface of the band and tube means for supplying drilling mud to the manifold. Said method comprises the steps of driving the pile into the earth by conventional means until the manifold reaches the particular elevation having negative friction and thence, while continuing to drive the pile, simultaneously forcing drilling mud into the manifold and upwardly out through the nozzles to fill the annular space between the walls of the pile and the adjacent earth at said particular elevation having negative friction.

In certain installations it is desirable to install drilling mud down to a certain elevation and thence change-over and install cement grout around the lower portion of the pile in order to overcome any negative friction effects in the upper portions of the driving. For such an installation the pile structure includes a pile, an annularly shaped band portion mounted around the periphery of the pile at the lower end thereof, an annular manifold having a plurality of upwardly directed nozzles mounted on the upper surface of the band and tube means for sequentially supplying drilling mud and thence cement grout to the manifold. A cement grout bonded interface is interposed between the pile and the adjacent earth at the lower portion of the pile. The method of forming the foregoing pile structure comprises the steps of driving the pile into the earth by conventional means while simultaneously forcing drilling mud into the manifold and upwardly out through the nozzles to fill the annular space between the walls of the pile and the adjacent earth at the upper portion of the pile structure, thence at a preselected elevation in the ground terminating the flow of drilling mud, then while continuing to drive the pile, simultaneously forcing grout down through said tubes into the manifold

means located on the upper surface of the band adjacent the lower end of the pile, and passing the grout upwardly out through the plurality of nozzles located in the upper surface of the manifold to completely fill the annular space between the walls of the pile and the adjacent earth at the lower portion of the pile. Upon completion of the driving of the pile to its desired depth in the earth, the flow of grout is terminated and the grout is allowed to set-up and form a bonded interface between the pile and the adjacent earth at the lower portion of the pile.

There has thus been outlined rather broadly the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described more fully hereinafter. Those skilled in the art will appreciate that the conception on which this disclosure is based may readily be utilized as the basis for the designing of other structures for carrying out the several purposes of the invention. It is important, therefore, that this disclosure be regarded as including such equivalent constructions as do not depart from the spirit and scope of the invention.

Several embodiments of the invention have been chosen for purposes of illustration and discussion, and are shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is an axial sectional elevation of a pile formation constructed in accordance with the concept of this invention;

FIG. 2 is a transverse sectional view taken along the line indicated at 2—2 of FIG. 1;

FIG. 3 is an axial sectional elevation of a pile formation according to another embodiment of the present invention;

FIG. 4 is an axial sectional elevation showing another embodiment of a pile structure according to the invention; and

FIG. 5 is an axial sectional elevation showing still another embodiment of pile structure according to my invention.

Referring to the drawings in detail, and initially to FIGS. 1 and 2, there is shown a pile structure indicated generally at 10, which includes an annular pipe pile 11, having walls 12, an annular, reinforcing cutting edge 14 mounted on the pile tip on the inside of the pile, and an annular inner grout manifold 16 mounted on the upper surface of the reinforcing band portion 18 of the cutting edge 14. The manifold is provided with a plurality of spaced upwardly directed nozzles 20, as best seen in FIG. 2. A pair of grout tubes 22, spaced about 180° apart, extend from near the top end of the pile downwardly adjacent the wall 12 of the pile and are in fluid flow communication with the manifold 16, as at 24, FIG. 1. The upper ends 26 of the grout tubes 22 are connected to a source of cement grout through a pump and hose connection, not shown. If, for example, a pipe having a diameter of about 36 inches with a wall thickness of about one inch is to be installed, the reinforcing band portion 18 would extend radially inwardly from the pile wall about two inches and a manifold of about two inches square would be employed, as shown in FIG. 1. The nozzle openings 20 would be spaced about one foot apart around the periphery of the pile.

The embodiment of FIG. 3 is similar to the embodiment of FIG. 1, except that the manifold 16' is round or of a hollow tubular-type construction, having a plurality of spaced upwardly directed nozzle openings 20'. In an installation of the aforesaid characteristics, the diameter of the tube type manifold would be about two inches and would extend around the periphery of the pile.

The pile is driven into the earth 28 with a force F by conventional driving means, not shown. As the pile is driven, a cement grout is pumped through the hose connection to the grout tubes 22 and then into the manifold 16, or 16', and out through the nozzle openings 20 or 20' of the manifold. An adequate quantity of grout is pumped so that the void left by the band portion 18 of the cutting edge 14 adjacent the inside of the pile is immediately filled with grout 27. This is controlled by maintaining a preselected head in the grout pumping system. A retarding agent can be added to the grout so that the grout does not harden until a preselected time has elapsed after completion of the driving operation in order to ensure that the driving operation is complete before the grout sets-up. The application of grout to the interior of the pile serves to reduce the driving force during the driving operation by reducing the friction between the pile 11 and the earth plug 29 inside the pile. In addition, after the grout 27 sets-up or hardens, it forms an interface bond between the pile and the earth plug, thereby greatly increasing the load carrying capacity of the pile.

As seen in FIG. 1, a band 30 is mounted adjacent the lower end of the pile 11. This band could be fabricated from any suitable material, such as steel, for example. The band extends radially outwardly from the pile wall about two inches and is positioned about six inches up from the lower end of the pile. The upper surface 32 of the band is flat and an annular outside grout manifold 34 is mounted thereon. The manifold is provided with a plurality of spaced upwardly directed nozzles 36. A pair of grout tubes 38 spaced about 180° apart extend from near the top end of the pile downwardly adjacent the wall 12 of the pile and are in fluid flow communication with the manifold 34 as at 39, FIG. 1. The upper ends 40 of the grout tubes 38, are connected to a source of cement grout in a manner similar to that described hereinbefore in connection with the upper ends 26 of the grout tubes 22.

The dimensions of the manifold 34 are similar to those of manifold 16 described hereinbefore. That is, if, for example, a pipe pile having a diameter of about 36 inches with a wall thickness of about one inch is to be installed, the reinforcing band 30 extends outwardly from the pile wall about two inches and the manifold 34 would be about two inches square and have nozzle openings 36 spaced about one foot apart around the periphery of the pile.

The embodiment of FIG. 3 is similar to the embodiment of FIG. 1, except that the manifold 34' is of a round or of a hollow tube type construction having a plurality of spaced, upwardly directed nozzle openings 36'. In an installation with the aforesaid characteristics, the diameter of the tube type manifold would be about two inches and would extend around the entire periphery of the pile.

As the pile is driven into the earth 28 with a force F, cement grout is pumped into and through the grout tube 38 and thence into the manifold 34, or 34', and

out through the nozzle openings 36, or 36', of the manifold. A sufficient quantity of grout is pumped so that the void left by the band 30 adjacent the outside of the pile is immediately filled with grout 42. The quantity is controlled by maintaining a preselected pressure head in the grout pumping system and as indicated hereinbefore, in connection with the grouting adjacent the inside of the pile. A retarding agent can be added to the grout so that the grout does not harden until a preselected time has elapsed to ensure that the driving operation is complete before the grout sets-up. The application of the grout for the exterior of the pile also serves to reduce the driving force during the driving operation by reducing the friction between the pile 11 and the surrounding earth 28, as well as providing an interface bond between the pile and the surrounding earth after the grout sets-up or hardens, thereby greatly increasing the load carrying capacity of the pile. This operation ensures a continuous coating of grout over the pipe and extends to the surrounding soil.

According to another form of my invention, as shown in FIG. 4, drilling mud 44 may be employed in place of the grout and installed around the outside of the pile. Thus, the drilling mud remains slippery on the outside of the pile where it is desired not to have friction developed between the pile and the ground 46. This type of installation is employed when so-called "negative friction" develops when settlement or consolidation of material around a pile causes overloading of the pile resulting in structure settlement. In this type of installation the bands 18' and 30 around the pile are installed at a selected elevation as indicated at 48 in the pile length, corresponding to the location of the negative friction.

The method of installing this form of pile structure includes the steps of driving the pile 11 into the earth by conventional means with a force F until the manifolds 16 and 34 reach the particular elevation 48 having negative friction and thence, while continuing to drive the pile, simultaneously forcing drilling mud 44 down the tubes 22 and 38 into the manifolds 16 and 34 and upwardly out through the nozzle openings 20 and 36 to fill the annular space between the wall 12 of the pile 11 and the adjacent earth having negative friction with drilling mud.

According to another form of my invention, as seen in FIG. 5, the pile structure includes a pile, annularly shaped band portions mounted towards the bottom of the pile, annular manifolds each having a plurality of upwardly directed nozzles mounted on the upper surface of the bands and tubes 22 and 38, all as described hereinbefore in connection with the embodiment of FIG. 1, as seen in FIG. 5. The upper ends 26,40 of the tubes are connected through valves 50 and 52 to a grout source 54 and to a drilling mud source 56, respectively.

The pile 12 is driven into the earth 58 having negative friction above a particular elevation, as indicated at 60, while simultaneously forcing drilling mud 44 down the tubes 22 and 38 into the manifolds 16 and 34 and upwardly out through the nozzle openings 20 and 36 to fill the annular space between the wall 12 of the pile 11 and the adjacent earth 58 above the elevation 60 with drilling mud from the drilling mud source 56 through the valve 52, valve 50 being closed. When the manifold reaches the elevation 60 in the ground, the valve 52 is closed and the valve 50 is opened. Then,

while continuing to drive the pile into the earth 62 beneath the elevation 60, grout is forced down from the grout source 54 through the tubes 22 and 38 into the manifolds 16 and 34 and upwardly out through the nozzle openings 20 and 36. A sufficient quantity of grout is pumped so that the voids left adjacent the pile below the elevation 60 are immediately filled with grout 64. The quantity is controlled by maintaining a preselected pressure head in the grout supply system. A retarding agent can be added to this grout so that the grout does not harden until a preselected time has elapsed to ensure that the driving operation is complete before the grout sets-up. There is thus formed a cement bonded interface 64 between the pile and the adjacent earth below the elevation 60.

It will thus be seen that the present invention does indeed provide an improved pile structure, and method of forming same, which is superior in simplicity and effectiveness as compared to prior art such pile formations.

Although certain particular embodiments of the invention are herein disclosed for purposes of explanation, various modifications thereof, after study of this specification, will be apparent to those skilled in the art to which the invention pertains.

What is claimed and desired to be secured by Letters Patent is:

1. A method of forming a pile structure in situ where the earth at particular elevations has negative friction, said pile structure having a pile, annularly shaped band means mounted around said pile at a location corresponding to said particular elevations having negative friction, an annular manifold mounted on the upper surface of said band means, said manifold having a plurality of spaced upwardly directed nozzle openings, tube means extending from near the top end of the pile downwardly to the manifold in fluid flow relationship with respect thereto, said method comprising the steps of driving said pile into the earth until said manifold reaches said particular elevations having negative friction, thence continuing driving said pile into the earth while simultaneously forcing drilling mud down through said tube means into said manifold and upwardly out through said plurality of nozzle openings to fill the annular space between the walls of said pile and the adjacent earth at said particular elevation having negative friction.

2. A method of forming a pile structure in situ where the earth above a particular elevation has negative friction, said pile structure having a pile, annularly shaped band means mounted adjacent the lower end of said pile, an annular manifold mounted on the upper surface of said band means, said manifold having a plurality of spaced upwardly directed nozzle openings, tube means extending from near the top end of the pile for sequentially supplying drilling mud and cement grout to said manifold, said method comprising the steps of driving said pile into the earth while simultaneously forcing drilling mud down through said tube means into said manifold and upwardly out through said plurality of nozzle openings to fill the annular space between the walls of said pile and the adjacent earth down to said particular elevation, when said manifold reaches said particular elevation terminating the flow of said drilling mud, thence continuing driving said pile into the earth while simultaneously forcing grout down through said tube means into said manifold and upwardly out

through said plurality of nozzle openings to completely fill the annular space between the walls of said pile and the adjacent earth below said particular elevation, upon completion of said driving of said pile to its desired depth in the earth terminating the flow of grout and allowing the grout to set-up and form a cement bonded interface between the pile and the adjacent earth only below said particular elevation.

3. A method of forming a pile structure in situ, said pile structure including a pipe pile having a reinforcing cutting edge adjacent the pile tip, said cutting edge having a reinforcing band portion adjacent its upper surface extending radially inwardly of said pile, an annular inner grout manifold mounted on the upper surface of said reinforcing band portion, said manifold having a plurality of spaced upwardly directed nozzle openings, grout tube means extending from near the top end of the pile downwardly adjacent the wall of the pile and in fluid flow communication with the manifold, said method comprising the steps of driving said pile into the earth while simultaneously forcing grout down through said grout tube means into said manifold and upwardly out through said plurality of nozzle openings to completely fill the annular space between the walls of said pile and the earth plug formed inside the pile, upon completion of said driving of said pile to its desired depth in the earth terminating the flow of grout and allowing the grout to set-up and form a cement bonded interface between the pile and the adjacent earth plug.

4. A method of forming a pile structure in situ according to claim 3, wherein said pile structure further includes an annular band mounted around the outside periphery of the lower end of said pile, an annular outside manifold mounted on the upper surface of said band, said outside manifold having a plurality of spaced upwardly directed nozzle openings, grout tube means extending from near the top end of said pile downwardly adjacent said pile walls to said outside manifold, said method further comprising the steps of forcing grout down through said grout tube means into the outside manifold and upwardly out through the plurality of nozzle openings in said outside manifold to completely fill the annular space between the walls of said pile and the adjacent earth around the outside periphery of said pile while driving said pile into the earth, upon completion of said driving of said pile to its desired depth in the earth terminating the flow of grout and allowing the grout to set-up and form a cement bonded interface between the pile and the adjacent earth surrounding said pile.

5. In a pile structure, the combination comprising a pile, an annular shaped band portion mounted adjacent the lower end of said pile, an annular manifold mounted on the upper surface of said band portion, said manifold having a plurality of spaced upwardly directed nozzle openings, means for mounting grout tubes extending from near the top end of the pile downwardly to the manifold in fluid flow relationship with respect thereto, and an interface of cement grout bonding the pile and the adjacent earth.

6. In a pile structure for use in earth having at particular elevations negative friction, said pile structure comprising a pile, annular shaped band means mounted around said pile at a location corresponding to said particular elevations having negative friction, an annular manifold mounted on the upper surface of said band

means, said manifold having a plurality of spaced upwardly directed nozzle openings, means for mounting tubes extending from near the top end of the pile downwardly to the manifold in fluid flow relationship with respect thereto, and an interface of drilling mud interposed between the pile and the adjacent earth at said particular elevations having negative friction.

7. In a pile structure for use in earth having negative friction above a particular elevation, said pile structure comprising a pile, an annular shaped band portion mounted adjacent the lower end of said pile, an annular manifold mounted on the upper surface of said band portion, said manifold having a plurality of spaced upwardly directed nozzle openings, means for mounting tubes extending from near the upper end of the pile downwardly to said manifold in fluid flow relationship with respect thereto, an interface of drilling mud interposed between the pile and the adjacent earth above said particular elevation, and an interface of cement grout bonding the pile and the adjacent earth below said particular elevation.

8. In a pile structure, the combination comprising a pipe pile, a reinforcing cutting edge mounted adjacent the pile tip, said cutting edge having a reinforcing band portion adjacent its upper surface extending radially inwardly of said pile, an annular inner grout manifold mounted on the upper surface of said reinforcing band portion, said manifold having a plurality of spaced upwardly directed nozzle openings, means for mounting grout tubes extending from near the top end of the pile downwardly to the manifold in fluid flow relationship with respect thereto, and an interface of cement grout bonding the pile and the adjacent earth plug.

9. A pile structure according to claim 8 wherein said manifold is of square configuration in cross section.

10. A pile structure according to claim 8, wherein said manifold is of round configuration in cross section.

11. A pile structure according to claim 8, further comprising an annular band mounted around the outside periphery of the lower end of said pile, an annular outside manifold mounted on the upper surface of said band, said outside manifold having a plurality of spaced upwardly directed nozzle openings, means for mounting grout tubes extending from near the top of the pile downwardly to the outside manifold in fluid flow relationship with respect thereto, and an interface of cement grout bonding the pile and the adjacent earth surrounding said pile.

12. In a pile structure, the combination comprising a pile, an annular band mounted around the outside periphery of the lower end of said pile, an annular outside manifold mounted on the upper surface of said band, said outside manifold having a plurality of spaced upwardly directed nozzle openings, means for mounting grout tubes extending from near the top end of the pile downwardly to the manifold in fluid flow relationship with respect thereto, and an interface of cement grout bonding the pile and the adjacent earth surrounding the pile.

13. A pile structure according to claim 12, wherein said manifold is of square configuration in cross section.

14. A pile structure according to claim 10 wherein said manifold is of round configuration in cross section.

15. In a pile structure, the combination comprising a pipe pile, a reinforcing cutting edge mounted adjacent the pile tip, said cutting edge having a reinforcing band portion adjacent its upper surface extending radially inwardly of said pile a distance of the order of about two inches, an annular inner grout manifold mounted on the upper surface of said reinforcing band portion, said manifold having a plurality of upwardly directed nozzle openings spaced on the order of about one foot between one opening and the next adjacent opening, means for mounting a pair of grout tubes spaced on the order of about 180° apart for extending from near the top end of the pile downwardly to the manifold in fluid flow relationship with respect thereto, and an interface of cement grout bonding the pile and the adjacent earth plug inside the pile.

16. A pile structure according to claim 15 further comprising an annular band mounted around the outside periphery and at a distance of the order of about six inches upwardly from the lower end of said pile, said band extending radially outwardly from said pile a distance of the order of about two inches, an annular outside manifold mounted on the upper surface of said band, said outside manifold having a plurality of upwardly directed nozzle openings, said nozzle openings being spaced on the order of about one foot between

one nozzle opening and the next adjacent nozzle opening around the periphery of said pile, means for mounting a pair of grout tubes spaced about 180° apart for extending from near the top end of the pile downwardly adjacent the pile to the manifold in fluid flow relationship with respect to said outside manifold, and an interface of cement grout bonding the pile and the adjacent earth surrounding said pile.

17. In a pile structure, the combination comprising a pipe pile, an annular band mounted around the outside periphery at a distance of the order of about six inches from the lower end of said pile, said band extending radially upwardly a distance of the order of about two inches, an annular outside manifold mounted on the upper surface of said band, said outside manifold having a plurality of spaced upwardly directed nozzle openings, said nozzle openings being spaced of the order of about one foot between one nozzle opening and the next adjacent nozzle opening, means for mounting a pair of grout tubes spaced on the order of about 180° apart for extending from near the top end of the pile downwardly to the manifold in fluid flow relationship with respect thereto, and an interface of cement grout bonding the pile and the adjacent earth surrounding said pile.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,852,971 Dated December 10, 1974

Inventor(s) Lindsey J. Phares

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 43, "outside mounted" to read
--outside manifold mounted--;

Column 8, line 61, "pile" to read --said pile--;

Signed and sealed this 10th day of June 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks