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Method for placing anchor pile, as for bracing an earth retaining wall, includes an anchor rod axially centered in a bore augered in an earth situs at a location including an overburden of loose earth held against movement along an inclined slippage plane by a retaining wall. An auger drill is progressively withdrawn from the bore while fluid hydraulic cement mortar is pumped through auger shaft to form a pile in the bore, to requisite extents above and below slippage plane, with a tie-back rod axially centered therein. While mortar in the bore is in partially set, but still somewhat soft condition, a hollow shafted auger is operated to drill a new hole in the formed pile, along central axis thereof, to adjacent slippage plane. Upon substantial hardening of the remainder of the formed pile, the portion of centered rod extending freely above the slippage plane will not be under any substantial degree of radial tension, which otherwise would have been applied by the overburden. A part of rod located in hole extending above the slippage plane is adapted to be selectively detached from the retained portion of the formed pile at point in the redrilled cavity, as for the purpose of subsequent removal of overburden to a selective lower level.

7 Claims, 4 Drawing Figures

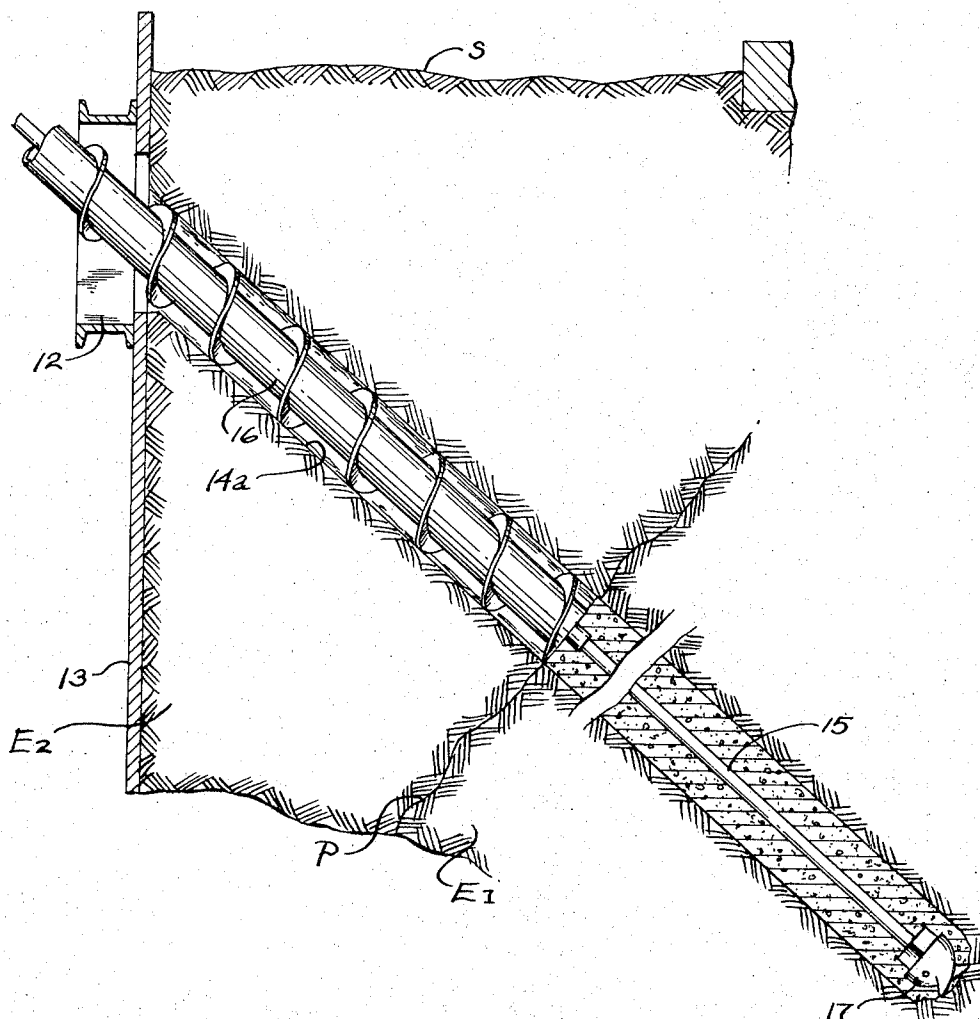


Fig. 1

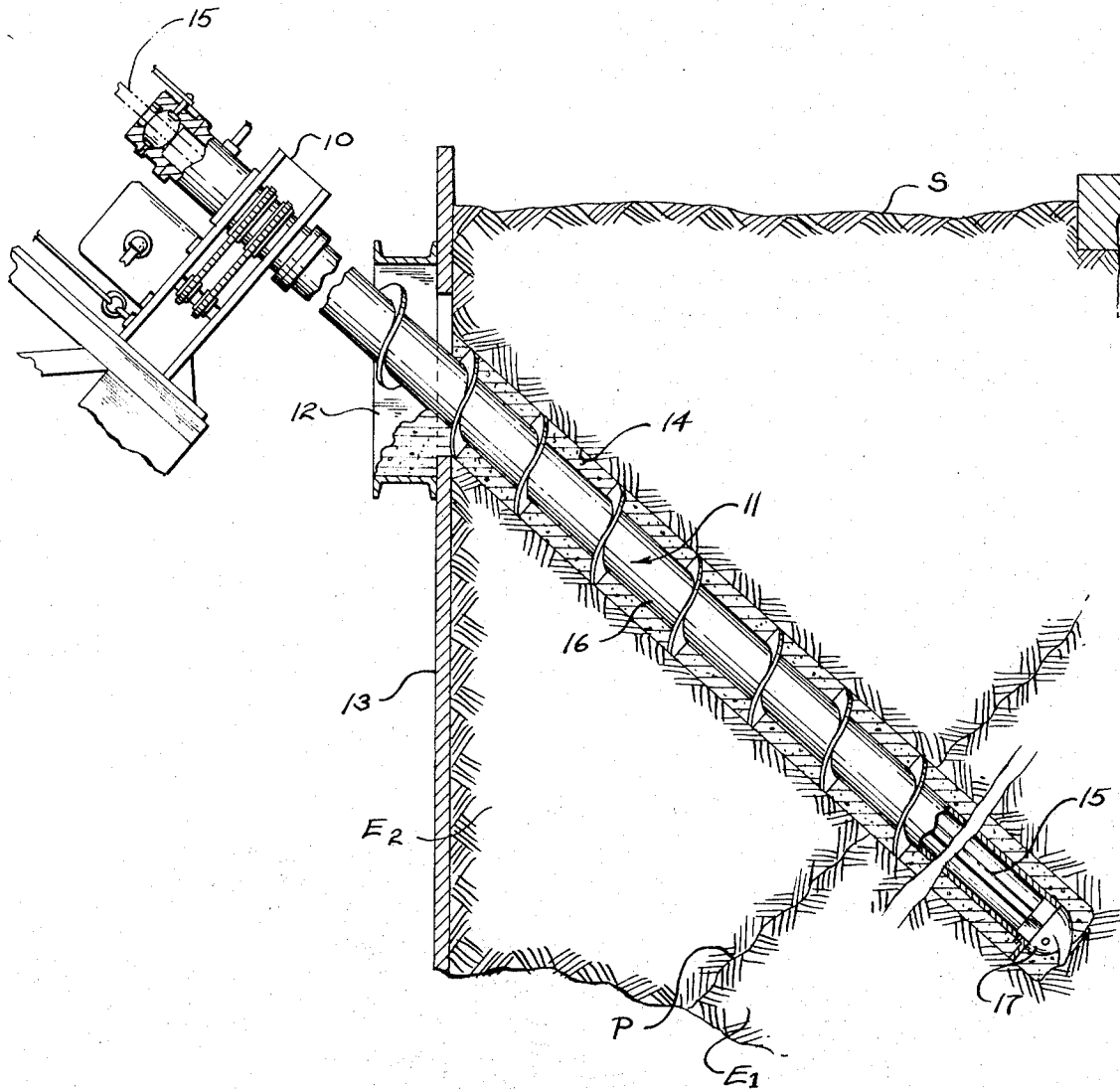


Fig. 2

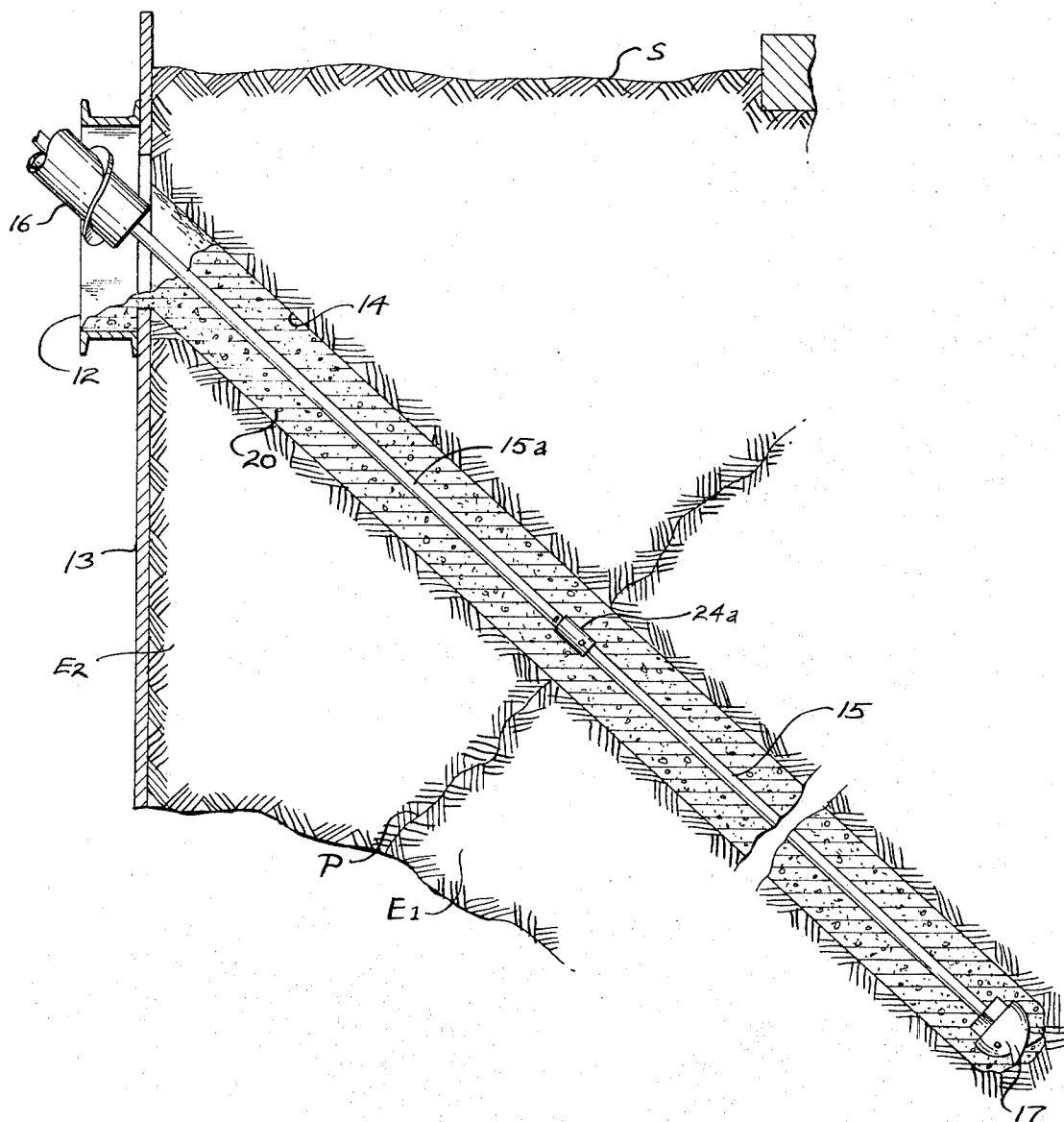


Fig. 3

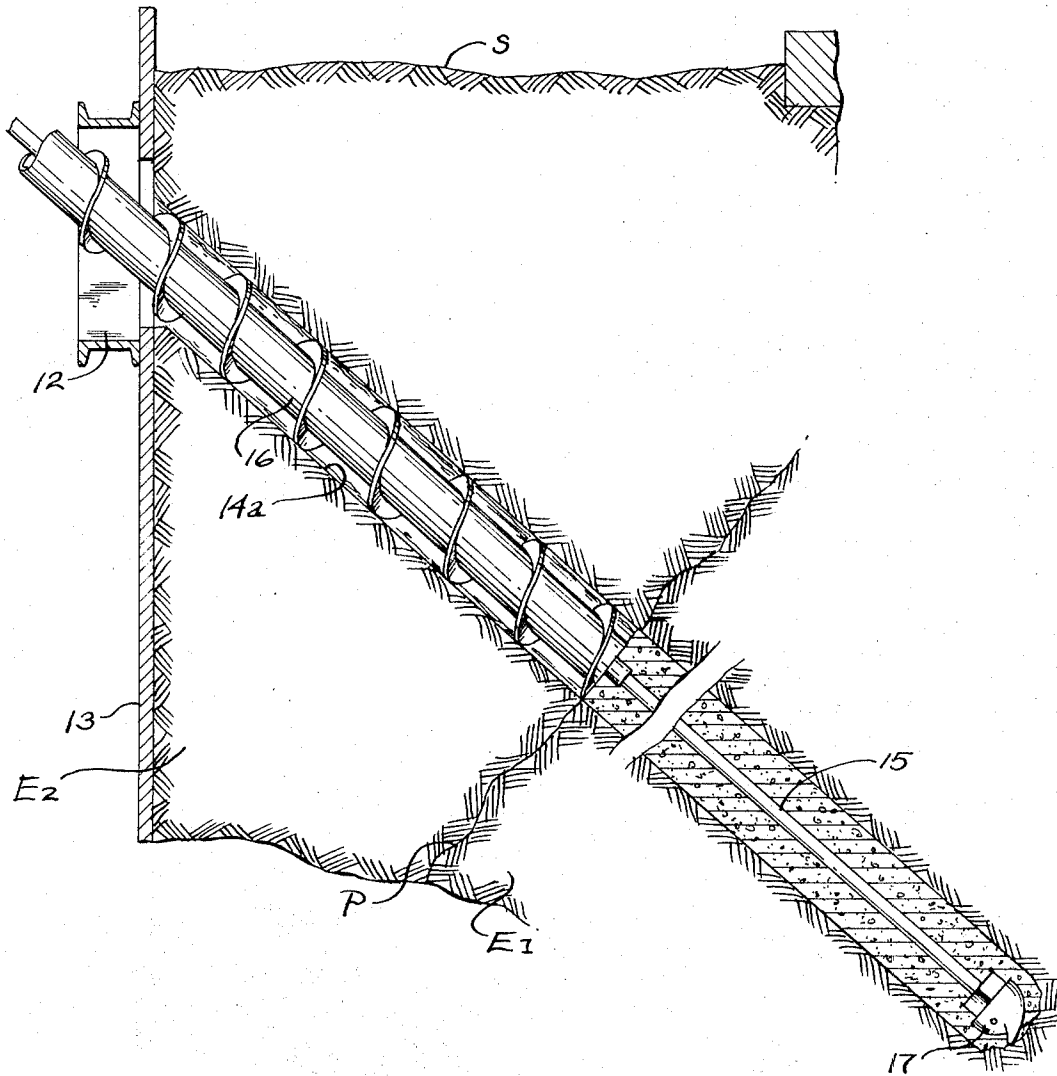
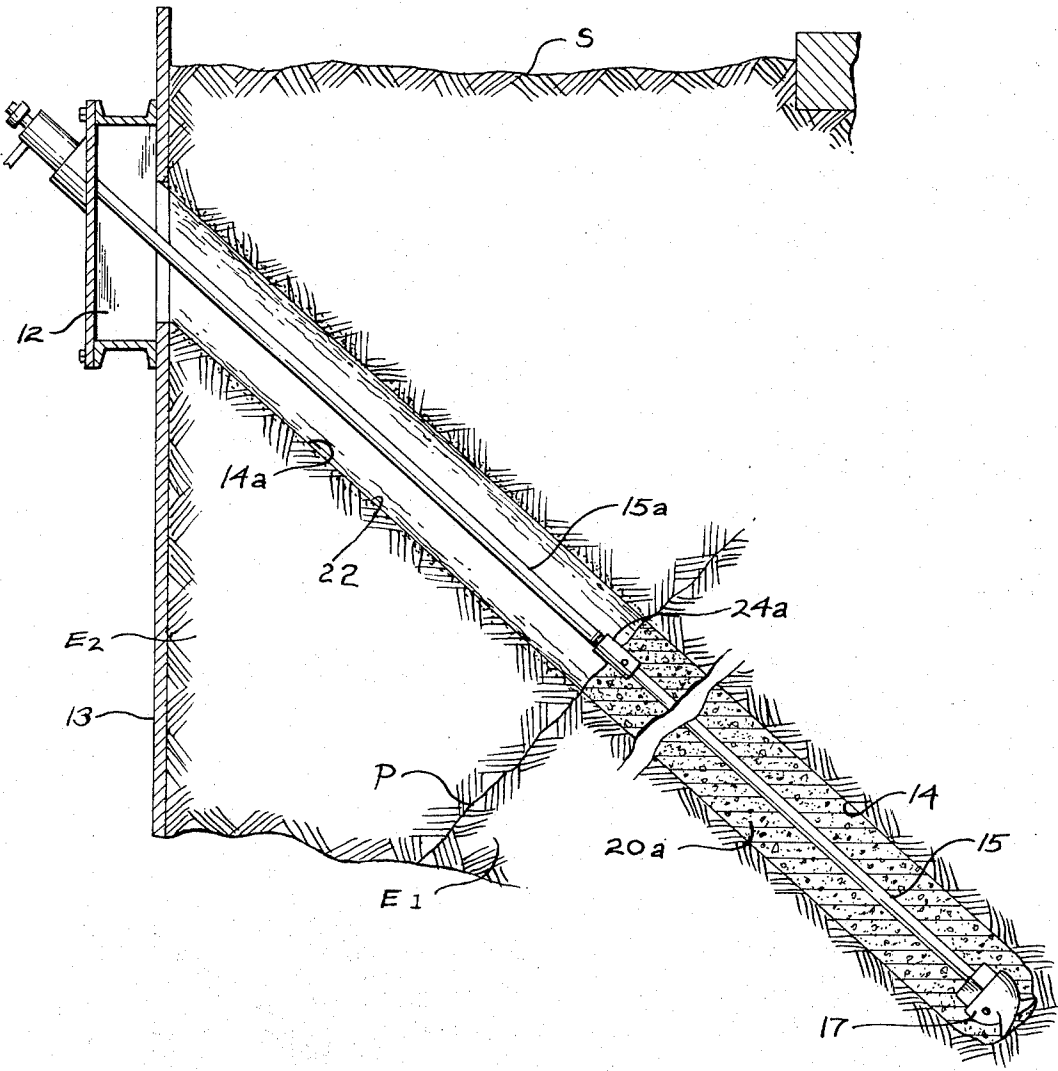


Fig. 4



METHOD FOR INSTALLING CONCRETE ANCHOR PILES IN SITU

BACKGROUND OF INVENTION

Heretofore, tie-backs have been placed in situ, as for shoring a retaining wall defining a lateral face for an excavation, to extend through an earthen overburden retained by the retaining wall to be anchored by a concrete anchor pile underlying the overburden. Schnable U.S. Pat. No. 3,541,798, for example, shows such an arrangement in which a tie-back rod extends at an angle to the horizontal centrally through a cavity drilled through the overburden, to be anchored in a concrete base or anchor pile in the underlayer below the overburden. There is no provision, in the Schnable disclosure of means or mode for ultimate removal of the rod from the base or anchor pile while the overburden is retained in the situs, and no means is shown or suggested for preventing the overburden at least along the slippage plane from applying substantial radial tension to the anchor rod, adversely to reduce the amount of tensional restraint that can be applied to the tie-back rod for retaining the shoring in requisite fixed condition.

SUMMARY OF INVENTION

The method of the present invention has particular utility for producing an anchor pile in an earth situs, as for anchoring a vertical retaining wall against movement of an overburden. For this purpose a hollow shafted auger may be drilled into the situs at a downward incline with reference to the retaining wall, and at a substantial angle to a slippage plane of the overburden, for example, to form a cavity of predetermined depth in the earth retained by the wall. Next, the auger is withdrawn from the cavity while replacing the removed earth with fluid, self-hardenable, cementitious material to form a pile body having an elongated tension element or anchor rod positioned centrally there-through as for anchoring attachment to the wall. While the formed pile body is in set but still penetrable condition a suitable hollow shafted auger is screwed into said body to remove an axially centered core of the cementitious material therefrom and to form a second cavity with a substantial extent of the anchor rod exposed within the cavity. Thereafter, the retained cementitious material, including at least a small thickness thereof adhered to or within the wall of the original cavity, is allowed to become set or at least partially hardened. In other words, the earthen wall of the original cavity will be protected by a thickness of cementitious material of sufficient consistency to prevent ingress of the surrounding earth into the second cavity around the rod, and thereby to obviate any chance of the overburden applying unwanted radial tension to the rod. A selective extent of the anchor rod within the redrilled cavity may be removed, as by disconnection of the rod at a screw threaded coupling or joint at a preselected depth in the cavity, thereby to facilitate removal of overburden above a given level upon completion of the work which required provision of the retaining wall in the first place.

A general object of the invention is to provide an improved method for installing a tie-back pile in an earth situs, as for affixing an earth-retaining wall against movement of an overburden in an earth situs, in a man-

ner by which the overburden is prevented from applying damaging radial tension to a tie-rod extending between the pile and the retaining wall.

Another object of the invention is to provide a method for installing a tie-back anchoring pile in a manner and for purposes described, by which a predetermined outer extent of the tie rod can be removed from the situs to permit removal of the overburden to a corresponding depth or level above the anchoring pile.

The foregoing and other objects of the invention will be manifest from the following brief description and the accompanying drawings. Of the accompanying drawings:

FIG. 1, is a vertical cross-section, partly broken away, through an earth situs and illustrating a completed step of the improved method by which a hollow-shafted auger has been screwed into an earth situs to define a cavity of requisite depth for installing a rod reinforced concrete pile, or an anchor-pile, as for anchoring an earth retaining wall.

FIG. 2 is a view corresponding to FIG. 1, in which the auger has been operated first to remove the augered earth from the cavity, and then to fill the cavity with fluid cement mortar for forming a concrete pile body with an anchor rod centered therein.

FIG. 3 is a view corresponding to FIG. 2, illustrating a further step of rotating the same or a different auger through an upper axial extent of formed pile body while the mortar is still in partly set, but relatively fluid consistency, and otherwise operated to form a new cavity of like extent with the reinforcing rod freely centered therein.

FIG. 4 is a view corresponding to FIG. 3, showing the completed anchor pile, in which the rod is anchored to the retained inner extent of now solid concrete pile, with the outer end of the rod affixed to a tension applying device secured to the retaining wall to hold the same in place.

Referring first to FIG. 1 of the drawings, there is illustrated earth drilling equipment 10, of known type such as disclosed in Turzillo U.S. Pat. No. 3,464,216 and by which a hollow shafted auger 11 has been passed through an aperture means 12 in a vertical earth retaining wall 13, and selectively rotated into the earth S behind the wall, thereby to define a first cavity 14 of predetermined depth or extent presented at a downward angle to the vertical plane of the retaining wall, and to a substantial inward depth beyond a soil slippage plane P. In this step of the method a tension rod 15, centered within a hollow shaft 16 of the auger, may be associated with a bit or other suitable closure member 17, releasably attached to the inner end of the auger as shown in FIG. 1, or as disclosed in Turzillo U.S. Pat. No. 3,354,657 as an example, or the rod 15 may be of a type adapted to be axially manipulated to knock the bit 17 from the auger shaft, in the manner disclosed in aforementioned Turzillo U.S. Pat. No. 3,464,216. Where, for example, the wall 13 is used to retain overburden E₂ of loose earth tending to move downwardly in reference to a slippage plane P at a right angle to the axis of the auger shaft, the drilling is continued to extend the thereby defined cavity to a desired or predetermined depth below the slippage plane P.

Next, the auger, with the closure member released as by axial movement of the rod 15 for inward passage of fluid, hydraulic cement mortar, under pressure may be

pumped into the cavity, from the lower end of the auger, to replace the earth removed from the cavity in timed relationship with progressive withdrawal of the auger until the cavity is filled with cement mortar around the rod and then the auger is fully withdrawn, whereby a pile body 20 is initially formed with the rod centered through the same, as shown in FIG. 2.

While the initially formed pile body 20 is in somewhat partially set, but unhardened condition, the same or a different hollow-shafted auger of smaller diameter may be screwed axially into said pile body to define a new cavity or hole 14a of the same or reduced diameter, which is thereby lined with a thickness or layer 22 of the aforesaid cement mortar adapted to set in due course, after removal of the newly inserted auger. The layer 22, upon becoming at least partially hardened or set, serves to prevent ingress of the overburden into the new cavity 14a and thereby obviates tensional restraint which would otherwise be applied to the portion of the tension rod presented above the slippage plane.

Upon eventual removal of the retaining wall, the upper extent 15a of the rod 15 may be removed, as by unscrewing the same at the coupling 24, located just above the anchoring pile portion 20a of the pile 20 retained below the slippage plane P. Removal of the upper part 15a of the rod 15 in this manner makes it possible to excavate earth to any desired level above the retained portion 20a of the anchor pile 20, after the retaining wall 13 has served its purpose and is no longer needed at the situs. After said removal of the rod part 15a the redrilled hole 14a may be filled with earth or other loose material, thereby to provide additional support of the overburden prior to said removal of the retaining wall 13, for example.

Modifications of the invention may be resorted to without departing from the spirit thereof, or the scope of the appended claims.

What is claimed is:

1. A method as for producing an anchor pile in an earth situs such as in a location including an overburden, comprising; forming a reinforced pile body of fluid, self-hardening cementitious material in a pile cavity extending through the overburden and into the situs inwardly of the overburden, with at least one elongated tension element extending through the formed pile body; screwing a hollow-shafted auger about said at least one element and into the formed pile body while the cementitious material thereof is in set, but somewhat unhardened, penetrable condition, thereby to define a new cavity therein through which a part of

said at least one element extends substantially freely of the overburden; and allowing the remainder of the formed pile body extending inwardly of the new cavity to harden, with an inner extent of said element anchored in said hardened remainder of the pile body.

2. A method as in claim 1, wherein said at least one element is rigid and includes a selectively removable extent thereof freely presented within the new cavity, and wherein the steps of the method include removal of at least a part of the free extent of the rigid element from said anchored inner extent thereof.

3. A method as in claim 2, wherein at least some of said overburden, above the hardened remainder of the pile body, is removed after said removal of the free extent of the rigid element.

4. A method of producing an anchor pile in an earth situs such as in a location including an overburden, comprising the steps of: screwing a hollow-shafted auger into the situs to predetermined depth and location to define a cavity therein passing through the overburden, by removal of the augered material; progressively withdrawing the auger from said cavity and replacing the removed material with fluid, self-hardenable cementitious material to form a pile body with an elongated rigid tension element positioned lengthwise therein said pile body extending through the overburden and into the situs inwardly of the overburden; screwing a hollow-shafted auger about said element and into the formed pile body while the cementitious material thereof is in unhardened, penetrable condition, thereby to form a new cavity around the rigid element in the area of the overburden; and allowing the remainder of the formed pile body extending inwardly of said new cavity to harden, and thereby anchor said rigid element thereto with an outer extent of the rigid tension element above said area of overburden substantially free from tensional restraint.

5. A method as in claim 4 wherein said rigid element is selectively releasably jointed at a point within said new cavity for removal of an outer extent of the element.

6. A method as in claim 5, wherein said outer extent of the rigid element is removed after said remainder of the formed pile body, inwardly of said new cavity, has hardened.

7. A method as in claim 6, including the step of removing at least some of said overburden overlying said remainder of the formed pile body after removal of said outer extent of the rigid element.

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