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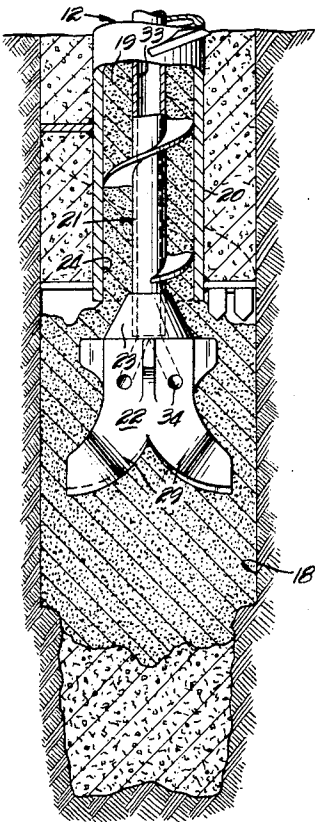
[54] **MEANS AND METHOD OF MAKING COLUMNAR STRUCTURES IN SITU**
31 Claims, 10 Drawing Figs.

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E02b 15/04
[50] Field of Search 61/63,
53.52, 53.6, 53.62, 53.64, 53.66, 11; 175/323, 171

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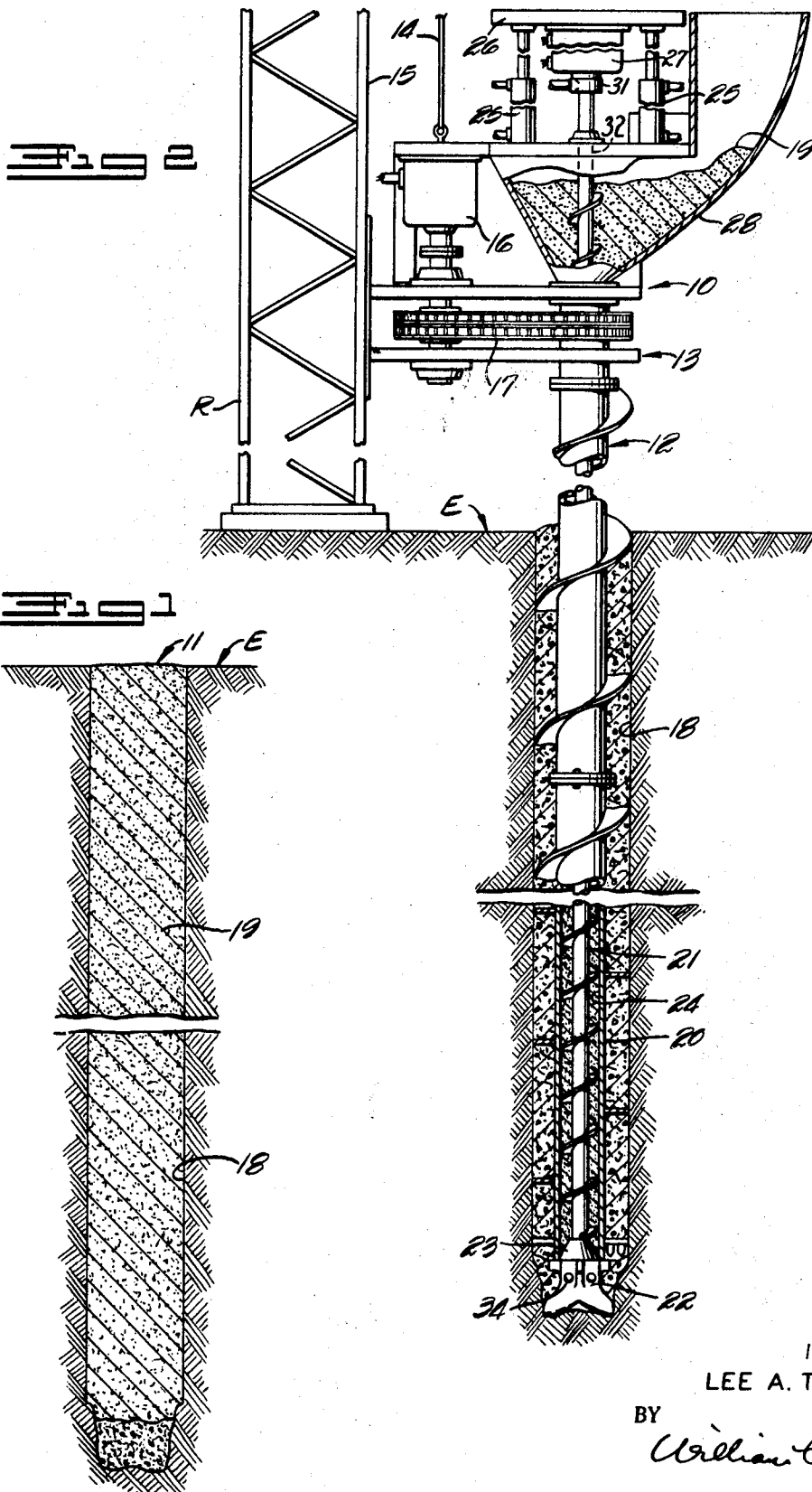
ABSTRACT: Method and means for providing pile or other structural column in earth situs, includes screwing hollow shafted auger into situs to form bore, and smaller auger is selectively axially shifted in the hollow shaft to move closure carried by smaller auger to selectively adjusted spacing of closure from closed position against inner end of hollow shaft. Larger auger progressively withdrawn from bore while rotating smaller auger in hollow shaft, forcibly to convey bore filling material through hollow shaft, past closure and be dispersed and compacted within the bore. Other means provided, separately supplying fluid material to bore through shaft of smaller auger for combination with materials conveyed into bore by auger flighting. Axially shiftable auger variously operable ahead of larger auger to test soil at different levels and/or to facilitate drilling use of larger auger.



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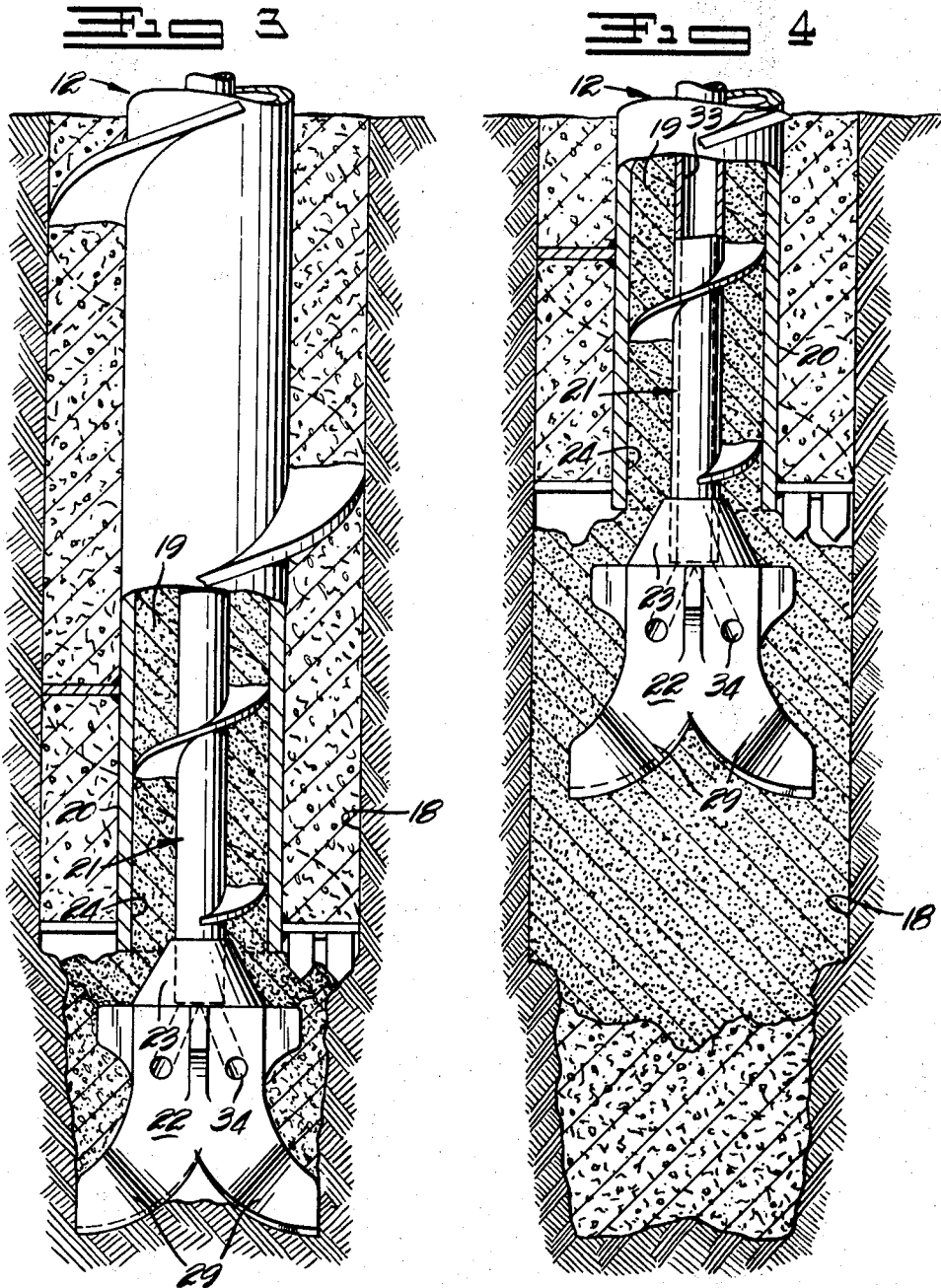


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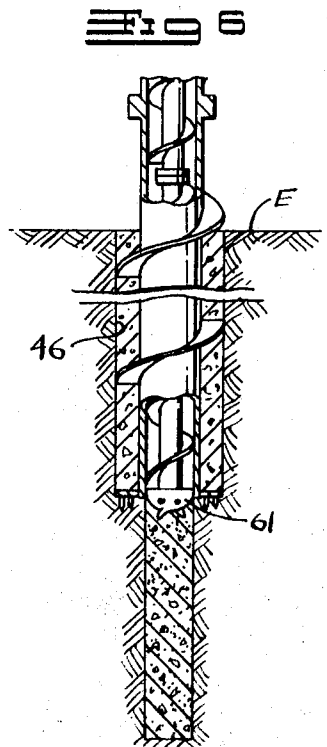
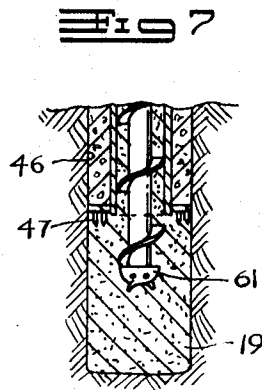
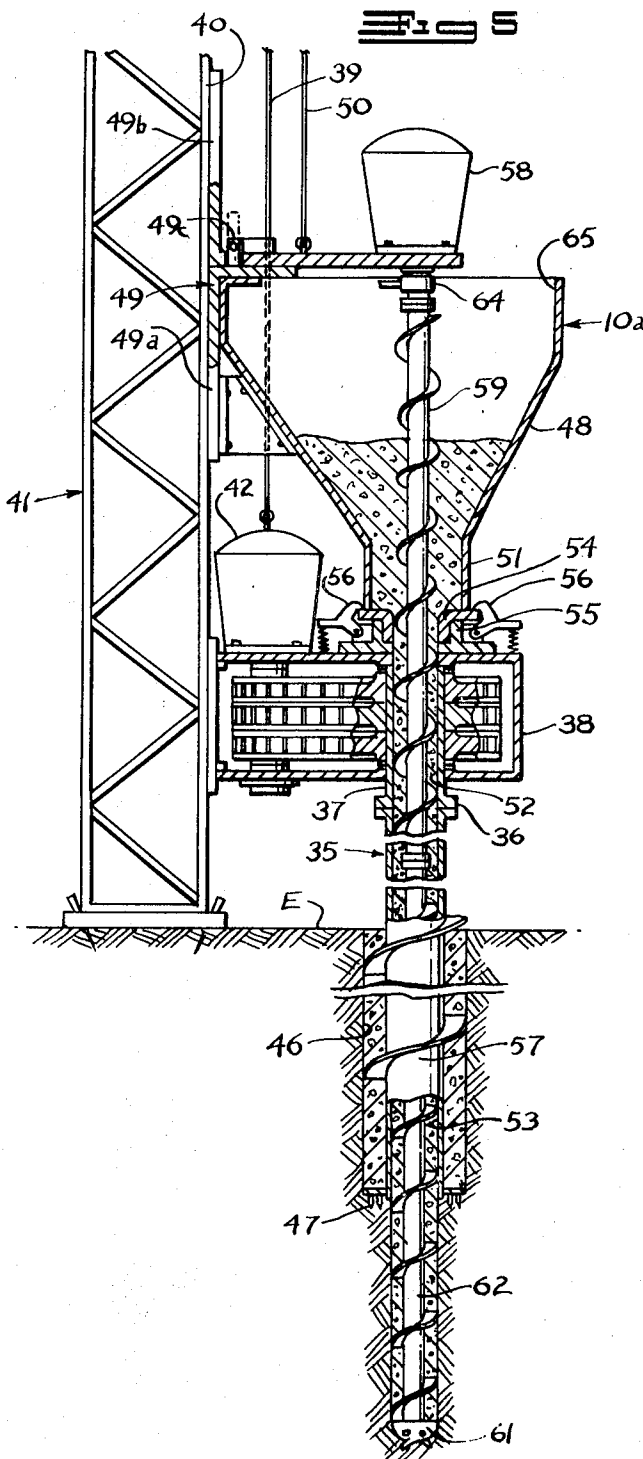
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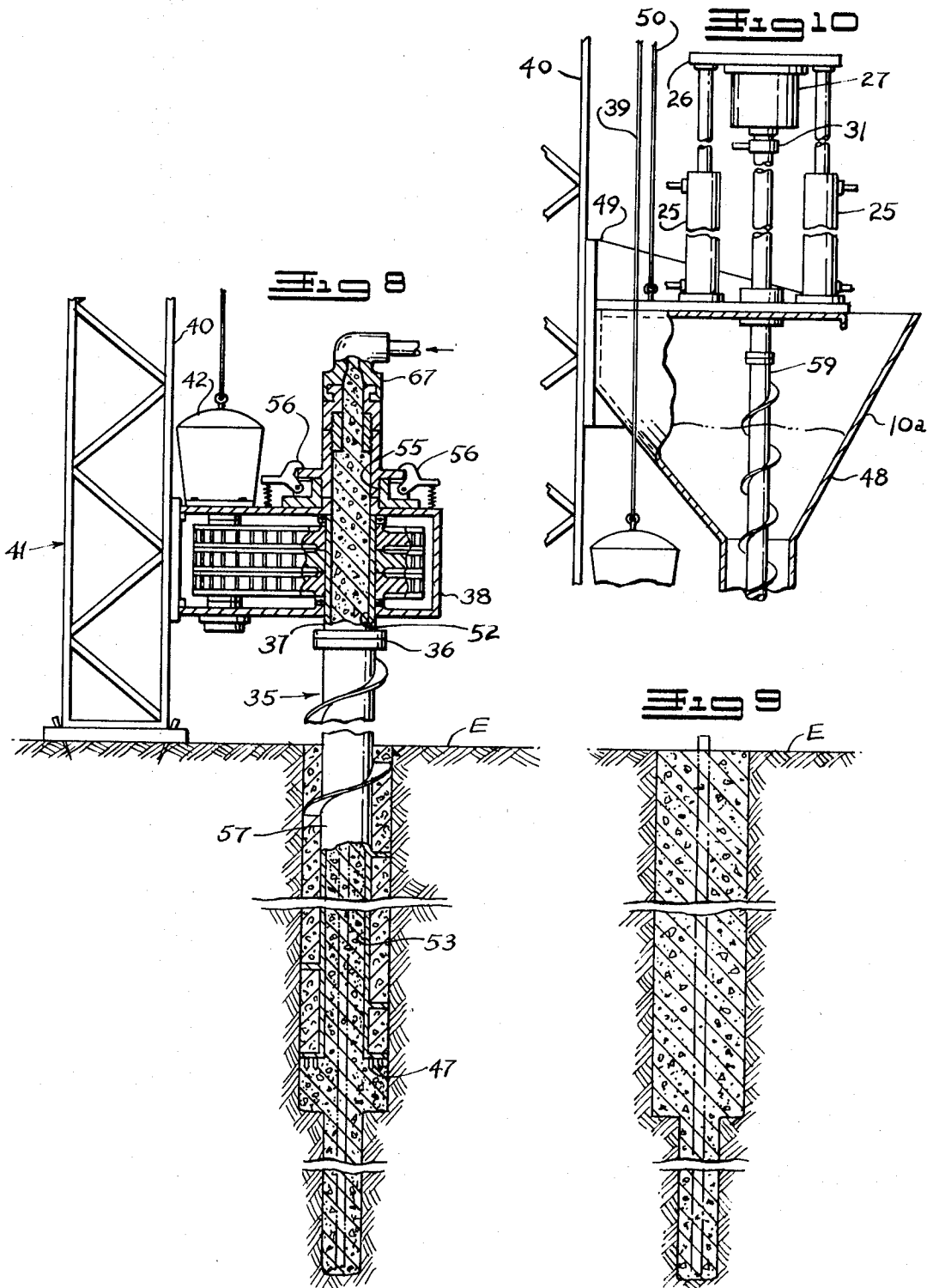
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MEANS AND METHOD OF MAKING COLUMNAR STRUCTURES IN SITU

This is a continuation-in-part of U.S. application Ser. No. 441,053, filed Mar. 19, 1965, now U.S. Pat. No. 3,426,538.

BACKGROUND OF INVENTION

In the past, columns, such as concrete piles, have been provided in an earth situs by augering a bore in the situs and while withdrawing the auger, pumping pressurized hydraulic cement grout into the bore. This method had many limitations in use, and the results attained were not always satisfactory or appropriate. Moreover, concrete piles made by use of a single auger were necessarily of limited size. Use of a hollow-shafted auger, or a pipe for feeding sand into an augered bore to construct a sand drain column was not practical because of a tendency for the sand to bridge across the passages in the auger shaft or pipe.

SUMMARY OF INVENTION

The invention employs an auger within an auger which is variously used to drill into an earth situs, as for making sand drains or cast-in-place concrete piles therein. As an example, the method and means may be used to provide a column of structural formation different from that of the situs, as by: screwing a hollow-shafted auger into the situs to form a bore therein of predetermined depth; selectively axially shifting a smaller auger within the hollow shaft of the larger auger to move a closure between a position closing the end of the hollow shaft and a position spaced below the end of the larger auger; and withdrawing the larger auger while rotating the smaller auger within the hollow shaft to convey material from a hopper along the flighting to be dispersed in the bore, with or without uniting with other materials fed through passage means in the shaft of the smaller auger, thereby to form the column within the bore. Variations in use of the method and means includes progressively drilling the bore with the larger auger with the rotated smaller auger extended in advance of the larger auger to drill a pilot hole for the same. After drilling to any total or partial depth in this way the smaller auger can be pulled independently of the larger auger to inspect or test earth formations from different levels in the bore. Many combinations of uses of the two augers are possible.

One object of the present invention is to provide an improved method and apparatus for forming sand drains in the earth, by which the resultant sand drainage core will be uniformly packed and free of voids.

Another object of the invention is to provide an improved method and apparatus for making sand drains, concrete piles, and other columnar structures to the full depth of drilled holes in the earth, progressively and simultaneously with removal of the earth materials from the hole with the drill.

Another object of the invention is to provide an improved method for making effective and efficient sand drain and other columnar structures, in the earth, to completion, with approximately the same amount of equipment handling as for augering the hole for the columnar structure, and in substantially the same length of time as normally required to auger said hole.

Another object of the invention is to provide variously operable auger within an auger device, of the character described, which makes it possible to drill relatively large bores using an auger of substantially greater diameter than normal, and to form a correspondingly larger column within the bore.

Another object of the invention is to provide improved method and means of the character described by which a stepped pile of predetermined load capacity can be formed, with or without elongated or other reinforcing means installed during the pile forming procedure.

These 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 through a sand drain in the earth, made by use of the improved method and apparatus of the invention.

FIG. 2 is a vertical cross section, on the same scale and partly broken away, illustrating the improved said drain making equipment, at a point in the method here the sand drain hole has been bored to full depth.

FIG. 3 is an enlarged vertical cross section, corresponding to the lower portion of FIG. 2, but illustrating the beginning of the operation of uniformly distributing sand within the bored hole.

FIG. 4 is a view corresponding to FIG. 3, illustrating another initial but subsequent period in the sand distributing operation of said equipment.

FIG. 5 is a vertical cross section, partly broken away and on reduced scale, illustrating a modified form of auger drilling equipment including an auger within an auger relationship, wherein the smaller auger serves as a pilot drill for the larger bore-drilling auger, as for providing a stepped concrete pile in the stepped bore formed thereby.

FIG. 6 is a fragmentary cross section corresponding to the lower portion of FIG. 5, but showing the smaller auger retracted to close the inner end of the hollow shaft of the larger auger, and utilizing the shaft of the small auger to pump grout into the bore made by the smaller auger.

FIG. 7 is a fragmentary cross section corresponding to FIG. 6, illustrating use of the same auger within an auger combination as for forcefully feeding sand into a bore made by the larger auger, to form a sand drain.

FIG. 8 is a view corresponding to FIG. 6, with the smaller auger replaced by an adapter including a swivelly connected grout supply head for supplying grout directly through the large auger shaft to the drilled bore, and through which pile reinforcing elements can be fed.

FIG. 9 is a view corresponding to FIG. 1, illustrating a stepped concrete pile formed by the improved method utilizing the equipment shown in FIGS. 5, 6, and 8.

FIG. 10 is a view showing modification of the equipment shown in FIG. 5, to incorporate auger reciprocating means of the type shown in the upper portion of FIG. 2.

Referring particularly to FIG. 2, there is illustrated apparatus 10 for practicing the method of the invention for making a sand drain 11 in an earth situs (see FIG. 1). Such apparatus may include a sectional, continuous flight, hollow shaft auger 12 rotatably mounted on a suitable carriage 13, which is vertically movable, by a hoist cable 14, on guide rails 15 of a drilling rig R. A reversing-type hydraulic motor 16 on the carriage 13 is selectively operable to rotate the auger 12 about a vertical axis thereof, through a connecting chain drive 17. Thus, the auger 12 is vertically operable to drill a bore 18 of any predetermined depth.

For feeding water pervious material, such as sand 19, into the bore, the hollow shaft 20 may have a smaller hollow-shafted auger 21 independently rotatably mounted thereon, as shown in FIGS. 2, 3, and 4. The driving bit 22, which normally would be affixed to the lower end of the larger auger, is in this case nonrotatably affixed to the lower end of the smaller auger, and is provided with a peripheral seat portion 23 normally held in abutment with the lower end of the auger shaft 20, to prevent passage of materials into or out of the shaft passage 24. The smaller auger 21, however, is selectively vertically reciprocable, between extended and retracted condition with respect to said lower end of auger shaft 20, to open and close the lower end of passage 24, as by means of simultaneously operable hydraulic cylinders 25, 25 mounted on the carriage 13, and selectively operable to reciprocate a support 26 for a hydraulic motor 27 which rotatably carries the smaller auger 21. Motors 16 and 27 may be synchronized to rotate as one in clockwise direction, during the operation of auger 12 for drilling the bore 18. When the bore has been drilled to requisite depth, however, as shown in FIG. 2, joint rotation of the two augers 12 and 21 is stopped, and the hydraulic cylinders 25, 25 are operated to ram the smaller auger 21 downwardly with respect to the larger auger 12 and, thereby,

to open the lower end of shaft passage 24, as shown in FIG. 3. While the larger auger 12 is slowly raised out of the formed earth bore 18, by means of hoist cable 14, the hydraulic motor 27 is operated to rotate the smaller auger in counterclockwise direction, uniformly and continuously to feed sand or other porous material from hopper 28 affixed on carriage 13 (see FIG. 2), downwardly in the auger shaft passage 24, and out through the open lower end of the same, with resultant uniform spreading and packing of the sand from wall to wall in the bore 18 (see FIGS. 3 and 4).

For the purposes described, the rotating bit 22 may be fish-tail shaped to have curvate portions 29, 29 which dig into the soil during the bore-drilling operation. In the reverse rotational operation of the bit, however, said curvate portions conversely will tend to pack the sand downwardly whereby upon complete removal of the combination auger from the bore, the resultant sand drain 11 will be free of objectionable materials and voids and have uniform water permeability (see FIG. 1).

Accordingly, the steps of the improved method basically include drilling a bore 18 in the earth formation E, requiring soil consolidation for supporting a heavy building or other construction thereon, as by means of the hollow, continuous flight, hollow shaft auger 12, to predetermined depth; and while progressively withdrawing the auger to remove the augered earth from the formed bore 18, simultaneously and progressively force-feeding sand through the passage in the auger 12 to fill the space within said bore left by progressive removal of auger 12 and the removed earth. As clearly described above, continuous downward feeding of the sand 19 may be accomplished by means of the selectively operable small auger 21 relatively rotatable within the larger auger shaft passage 24 to force the sand through said passage and into the augered bore. The continuous mechanical impacting of the sand 19 into the augered bore, assures uniform distribution and packing of the sand to the full depth of the bore for most effective and efficient consolidation of the surrounding earth formations, in accordance with the stated objects of the invention.

It will be readily apparent that the method and apparatus may have uses for other than constructing sand drains. That is, loose materials other than sand may be mechanically fed through the hollow shaft auger 12 and likewise progressively compacted to the full depth of the augered bore. As an example, concrete or other fluid cementitious material may be fed into the bore 18 in this manner to form a solid supporting pile or column, and thereby eliminate the heavy expensive grout-pumping equipment generally required for installing concrete piling.

If it is desired to fill the bore 18 with material under pressure, such as self-hardening fluid grout, the same may be pumped from a suitable source through a swivel joint 31 connected at or near the upper end of a conduit extension 32 of small auger 21, the passage 33 in the hollow shaft of auger 21, and outlet ports 34, 34 in driving bit 22, and into the bore. Fluid grout, for example, may be pumped in this manner while the end of the larger auger 12 is open at the bottom, as shown in FIGS. 3 and 4, or closed, as shown in FIG. 1. Water may be pumped through the shaft of small auger 21 while simultaneously feeding a bulk material, such as a concrete mix, down the hollow shaft of said larger auger, and these separately introduced materials may be blended together as the auger 12 is withdrawn from the bore, in the manner previously described.

It is also possible by means of the small auger 21, for example, to feed granular material, such as pea gravel or coarse aggregate from hopper 28 into the hole 18, (as shown in FIGS. 3 and 4), simultaneously with feeding or pumping fluid grout under pressure through the passage 33 of the small auger, as necessary, to provide a requisite concrete mix in the hole. Accordingly, the materials may be blended to suit varying conditions at different levels within the hole, as an example. In this way, it is possible to form a concrete pile according to variable specifications, simultaneously with removal of the earth materials from the hole with the hole-drilling unit.

When fluid grout is supplied to the bottom of the hole 18 through the passage 33 of the small auger, with or without additional granular material, as described above, any water and/or residual earth material material, in the hole 18 will be displaced by the pressurized grout as the auger unit is progressively withdrawn from the hole.

By reference to FIG. 2, it will be seen that the aforementioned sand, concrete, pea gravel, coarse aggregate, or blends of materials, can be supplied to the relatively fixed hopper 28 through the open top thereof while the augers 12 or 21 are rotating or stationary. By the same token, materials conveyed upwardly into the hopper by the smaller auger 21 can be viewed or sampled for inspection purposes while the two augers are rotating or stationary.

FIG. 5 illustrates modified auger within an auger equipment 10a for practicing methods of the invention in a wider variety of uses and with a minimum amount of labor and complicated mechanisms. For producing a stepped concrete pile in an earth situs E, for example, the augering equipment may include a relatively large, sectional, continuous flight auger 35 releasably affixed by means of a coupling 36, to an adapter tube 37, rotatably mounted on a carriage 38 which is, by a hoist cable 39, vertically movable along guide rails 40 of drilling rig 41. A reversible hydraulic motor 43, on carriage 38, is selectively operable through adapter 37 to rotate the auger 35 about a vertical axis of the same for drilling a large diameter bore 46 of requisite extent in the situs E, in accordance with methods to be described later. Cutting teeth 47 or other driving means may be provided on the lower end of auger 35.

A hopper 48 may be affixed on lower part 49a of a two-part carriage 49, to be vertically movable therewith along the upright guide rails 40, by means of a hoist cable 50, either concurrently with or independently of the carriage 38. For this purpose, the hopper 48 converges to a tubular section 51 having a nonrotatable, quickly releasable connection to the carriage 49 to communicate the interior of the hopper with the cylindrical passage 52, through adapter tube 37, to the passageway 53 of the large auger 35, without interfering with rotation of the auger. To this end, the hopper section 51 may have affixed to its lower end a centrally apertured annulus 54, held complementally and nonrotatably seated in peripheral seat means 55 on carriage 38, as by a plurality of quick-acting, spring-pressed latches 56, 56, provided on a fixed part of the carriage 38.

A reversible hydraulic motor 58 mounted on upper part 49b of two two-part carriage 49, releasably attached to part 49a thereof, carries a relatively small, continuous flight sectional auger 59 to extend through the hollow shaft 57 of the large auger 38, selectively to be rotated at the same time or independently thereof, in any rotational direction. For ease of changing the lengths of both augers at the same time, the small auger 59 may have a releasable coupling 60 of known type, slightly below the coupling 36 of the large auger. In this way, the small auger selectively may be made to extend either beyond the inner end of the large auger as shown in FIG. 5, or to position a combined driving bit and closure member 61, affixed on the hollow shaft 62 of the small auger, within the passageway 53 of the larger hollow shaft 57. Auger 59 may be reciprocated toward and from the FIG. 6 closed position of closure 61, by releasing latch means 56, thereby through cable 50 to raise or lower the carriage 49 with hopper 48 thereon. This actuation of carriage 49 also may be utilized to empty hopper 48, or to inspect soil of the situs collected in the flighting of the small auger. Alternatively, auger 59 may be similarly reciprocated or retracted, without hopper 48, by releasing upper carriage part 49b from carriage part 49a at 49c.

For certain purposes, fluid hydraulic cement mortar or grout, under pressure, may be pumped through the hollow shaft of small auger 59, through a suitable swivel connector 64 at the upper end thereof.

The relatively fixed hopper 48 may have a convenient top opening 65, as for supplying sand or other materials through large auger shaft 57, under the condition shown in FIG. 5, as for inspecting materials elevated into the hopper by the small auger.

FIG. 8 shows the auger-drilling apparatus substantially as in FIG. 5, except that the smaller auger has been removed as described, for pumping hydraulic cement grout, or other fluid material directly through the large auger shaft 57 into the bore made by the double auger combination. For this purpose, the hopper 48 is elevated out of the way by means of cable 50, and replaced by a fluid grout valving adapter, including the same or a different annulus 54, as described above, but also carrying a quick release, swivel connector unit 66 connected to a supply of said hydraulic cement grout. A relatively rotatable cap 67 is quickly releasable from the unit 66 to permit insertion of reinforcing bars, wire cage means, or similar devices, through the large auger shaft 57 and into a bore made in the situs E, to become embedded in a concrete column being formed in the bore, generally as indicated in chain-dotted lines in FIGS. 8 and 9.

In one form of the improved method, for making stepped concrete piles, the apparatus generally as shown in FIG. 5 may be used, wherein the two carriages 38 and 49 are rigidly connected to have a selective length of the small auger extended from the lower end of the hollow shaft of the larger auger. With downward movement of the connected carriages on the guides 40, the rotating small auger penetrates the situs E ahead of the rotating larger auger, until a stepped bore of requisite depth is formed. Next, the small auger may be withdrawn as by shortening the length thereof, or by moving carriage 49 upwardly of the carriage 38, until closure 61 closes the passage 53 to the bore. In any event, the equipment is operated as described to withdraw the augers from the formed bore, thereby removing the earth therefrom, and simultaneously pumping pressurized cement grout through swivel 64, small auger shaft 62, and the apertured closure 61, into the bore, progressively to fill the bore with the self-hardening concrete material, as shown in FIG. 6, to a point.

Under similar operational procedure, as for making a sand drain column, the small auger with closure 61 thereon can be left in partially extended open position as the two augers are progressively retracted, while the large auger is progressively withdrawn or operated to remove the earth in its flighting from the bore, and while the small auger is appropriately rotated to convey sand down its flighting into the bore, in the manner shown in FIG. 7. This operation is continued until the bore is solidly packed with sand. Sand for this purpose may be most conveniently supplied to the static hopper while it is near ground level, whether the augers are rotating or not. The pilot penetration by the small auger can be eliminated for sand drain purposes, or selectively enlarged by drilling deeper with the larger auger (see FIG. 7). In other words, the sand drain column shown in FIG. 1 can be made by this method.

In modified procedure, particularly where a concrete pile, stepped or otherwise, is required to be reinforced, the boring procedure may be followed as described above to form the required stepped bore to the point shown in FIG. 6. The hopper 48, however, is then elevated by cable 50 after releasing the spring-pressed latches 56, to remove the small auger from the large auger. Next, the annulus 54 of swivel connector unit 66 is nonrotatably affixed to the seat means 54 on carriage 38. Then, as the large auger is progressively retracted from the bore, pressurized grout is pumped through the hollow auger shaft 57, progressively to fill the bore and form the stepped pile therein as shown in FIG. 9. When reinforcement of the pile is called for, the bore-filling procedure is halted while the pumped cement grout is still soft, to remove cap 67 temporarily, and permit inserting one or more elongated reinforcing elements or cages down the auger shaft 57, as indicated in chain-dotted lines in FIG. 8. Upon replacement of cap 67, the grout-pumping procedure may be resumed toward complete withdrawal of the large auger, and full formation of

a completed stepped pile, as shown in FIG. 9. Because of the obvious simplicity of the improved apparatus described and the versatility of operation of the same, a substantial number of variations in procedure are possible for forming columns of different structural characteristics in the situs.

By vertically operating the two carriages independently, and using a small auger 58 of suitably increased lengths, two augers can be selectively axially adjusted in various relationships to pump fluid cement grout through the shaft of the small auger to the bore 46, as the larger auger is progressively withdrawn from the bore.

In some circumstances, it may be desirable to reciprocate the small auger 59 (see FIG. 5) within the larger auger without separating the hopper 48 from the carriage 38 by releasing carriage part 49b from carriage part 49a.

Alternatively, for the last described purposes, the auger reciprocating mechanism shown at the upper portion of FIG. 2 may be mounted on the carriage 49, as shown in FIG. 10, in which like parts are indicated by like numerals unless otherwise noted. That is, by means of the hydraulic cylinders 25, the smaller auger 59 is axially shiftable within the larger auger 35, whether rotating or not, either to open and close the inner end of the larger auger, or to extend to selective degree ahead of the same as a pilot drill, as shown in FIG. 5.

By use of the various forms of auger within an auger structure, described above, and exemplified in FIGS. 5, 8, and 10, the larger auger can be of substantially greater size than normal to produce correspondingly larger and/or longer concrete piles, for example, as compared with results attained by use of a single auger.

In use of the several forms of auger within an auger equipment described above, it is to be particularly noted that the two augers can be rotated either together or independently of each other, and that they can be axially shifted relatively of each other or in unison. It is also important that sand or other bulk materials can be fed at controlled rates from the stationary hopper into the drilled bore, by means of the small auger, and the volume of material so used can be measured by the r.p.m. of the smaller auger.

Other modifications of the invention may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. Apparatus for providing in a situs of earth formation a core of a different material, comprising: a hollow-shafted, continuous flight auger having inner and outer ends; means for rotating and urging said hollow-shafted auger into said earth formation to form a hollow bore therein; a smaller continuous flight auger rotatably mounted in the hollow shaft of the larger auger, and having a closure on the inner end thereof for opening and closing the inner end of said hollow shaft; supply means for supplying a said different material to the outer end of the smaller auger; means for axially shifting said smaller auger within said hollow shaft; and means for rotating said smaller auger within said hollow shaft, and operable in the open position of said closure to force feed material from said supply means inwardly through the hollow shaft and into the hollow bore; said means for axially shifting being selectively operable to project said smaller auger beyond said inner end of the larger auger, as for drilling in the situs, a bore of smaller cross section than said bore made by the larger auger.

2. Apparatus as in claim 1, said means for rotating the augers being selectively operable to rotate the augers either simultaneously or independently of each other.

3. Apparatus for providing in a situs of earth formation a core of a different material, comprising: a hollow-shafted, continuous flight auger having inner and outer ends; means for rotating and urging said hollow-shafted auger into said earth formation to form a hollow bore therein; a smaller continuous flight auger rotatably mounted in the hollow shaft of the larger auger; supply means for supplying a said different material to the outer end of the smaller auger; means for axially shifting said smaller auger within said hollow shaft and means for

rotating said smaller auger within said hollow shaft, to force feed material from said supply means inwardly through the hollow shaft and into the bore; said means for axially shifting being selectively operable to project a force-feeding extent of

4. Apparatus as in claim 3, said means for rotating the augers being selectively operable to rotate the augers either simultaneously or independently of each other.

5. Apparatus as in claim 4, including movable supporting means being provided for supporting said larger and smaller augers, for selective simultaneous or independent rotation thereon in either direction relatively of each other.

6. Apparatus as in claim 5, said smaller auger having an apertured passageway through a shaft thereof connected to an external source of fluid supply for supplying the fluid through the passageway to the bore.

7. Apparatus for providing in a situs of earth formation a core of a different material, comprising: a hollow-shafted, continuous flight auger having inner and outer ends; means for rotating and urging said hollow-shafted auger into said earth formation to form a hollow bore therein; a smaller continuous flight auger rotatably mounted in the hollow shaft of the said larger auger; supply means for supplying a said different material to the outer end of the smaller auger; means for axially shifting said smaller auger within said hollow shaft; and means for rotating said smaller auger within said hollow shaft, to force-feed material from said supply means inwardly through the hollow shaft and into the bore; said means for axially shifting being selectively operable to project said smaller auger ahead of the larger auger, as for drilling a stepped bore in the situs; said means for rotating the augers being selectively operable to rotate the augers either simultaneously or independently of each other; movable supporting means being provided for supporting said larger and smaller augers, for selective simultaneous or independent rotation thereon in either direction relatively of each other; power means being provided on said movable supporting means to shift said smaller auger axially within said hollow shaft; and a closure on the inner end of said smaller auger to be axially shiftable therewith by said power means to open and close the inner end of said hollow shaft to passage of a said different material from said supply means.

8. Apparatus as in claim 7, said supply means including a hopper mounted on said movable supporting means with the outer end of said larger auger rotatably connected thereto, whereby material can be supplied to the hopper while said augers are rotating or stationary.

9. Apparatus for providing in a situs of earth formation a core of a different material, comprising: a hollow-shafted continuous flight auger having inner and outer ends; means for rotating and urging said hollow-shafted auger into said earth formation to form a hollow bore therein; a smaller continuous flight auger rotatably mounted in the hollow shaft of said larger auger; supply means for supplying a said different material to the outer end of the smaller auger; means for axially shifting said smaller auger within said hollow shaft; and means for rotating said smaller auger within said hollow shaft, to force-feed material from said supply means inwardly through the hollow shaft and into the bore; said means for axially shifting being selectively operable to project said smaller auger ahead of the larger auger, as for drilling a stepped bore in the situs; movable supporting means being provided for supporting said larger and smaller augers the bore; selective simultaneous or independent rotation thereon in either direction relatively of each other; said supply means including a hopper mounted on said movable supporting means with the outer end of said larger auger rotatably connected thereto, whereby material can be supplied to the hopper while said augers are rotating or stationary.

10. Apparatus for providing in a situs of earth formation a core of a different material, comprising: a hollow-shafted, continuous flight auger having inner and outer ends; means for rotating and urging said hollow-shafted auger into said earth

formation to form a hollow bore therein; a smaller continuous flight auger rotatably mounted in the hollow shaft of the larger auger; supply means for supplying a said different material to the outer end of the smaller auger; means for axially shifting said smaller auger within said hollow shaft; and means for rotating said smaller auger within said hollow shaft, to force-feed material from said supply means inwardly through said hollow shaft and into the bore; said means for axially shifting being selectively operable to project said smaller auger ahead of the larger auger, as for drilling a stepped bore in the situs; said supporting means including upper and lower parts carrying said smaller and larger augers, respectively, and releasable connector means connecting said supporting parts to be releasable for movement of said parts and axially shifting said augers relatively of each other.

11. Apparatus as in claim 10, including adapter means, interchangeable with said upper supporting part through said releasable connector means upon removal of the smaller auger with said upper supporting part, for supplying fluid material from a source thereof through said hollow shaft to said bore.

12. Apparatus as in claim 11, said means for axially shifting including guide means on which said movable supporting means rides, and hoist means for shifting said movable supporting means along said guides.

13. Apparatus as in claim 12, said smaller auger having passage means through shaft thereof and swivelly connected at the upper end of the same to a source of pressurized fluid material for supplying the fluid material therefrom to the interior of said bore.

14. Apparatus as in claim 13, said smaller auger having an apertured closure on the inner end thereof for opening and closing said passageway to said bore by axially repositioning the augers relative to each other.

15. A method of providing a stepped bore in an earth situs, comprising the steps of: progressively screwing a hollow-shafted, continuous flight auger into the situs toward selective depth for forming a bore of corresponding diameter by upward removal of earth material in the auger flighting; rotating a relatively smaller, continuous flight auger within the hollow shaft of the larger auger while projecting a substantial drilling extent of the smaller auger beyond the inner end of the larger auger to form a bore of correspondingly smaller diameter than that formed by the larger auger; and feeding a supply of filler material into the drilled bore through the hollow shaft of the larger auger as it is withdrawn from the bore.

16. A method as in claim 17, wherein said smaller auger is selectively rotatable for conveying filler material along the flighting thereof to form a stepped column within stepped bore formed by the larger auger and said drilling extent of the smaller auger.

17. A method as in claim 16, wherein said filler material includes fluid hydraulic cement mortar pumped through the shaft of the smaller auger into the bore, simultaneously with withdrawal of the larger auger from the bore.

18. A method as in claim 15, wherein the filler material is a granular substance fed inwardly through the hollow shaft by the flighting of the smaller auger into the bore while the larger auger is being withdrawn therefrom.

19. A method as in claim 15, wherein the filler material is fluid hydraulic cement grout pumped through said hollow shaft into the bore while larger auger is being withdrawn from the bore.

20. A method of providing a stepped bore in an earth situs, comprising the steps of: screwing a hollow-shafted auger into the situs while simultaneously rotating a relatively smaller, continuous flighted auger within the hollow shaft of the larger auger to present a substantial drilling extent of the smaller auger beyond the inner end of the larger auger to pilot the larger auger; and wherein at least one rigid element is positioned longitudinally within said hollow shaft, upon removal of said smaller auger from the larger auger, and fluid hydraulic cement grout is pumped into the bore through the hollow shaft

to form a concrete pile within the bore to have said at least one rigid element embedded therein.

21. A method as for providing in an earth situs, a column of structural formation different from that of the situs, comprising the steps of: screwing a hollow-shafted auger into the situs while simultaneously rotating a relatively smaller, flighted auger within the hollow shaft of the larger auger to present and expose a flighted extent of the smaller auger beyond the inner end of the larger auger, thereby to drill a second bore into the situs ahead the larger auger; and progressively withdrawing the larger auger while rotating said smaller auger within the hollow shaft to convey bore filler material, from a supply thereof at the upper end of the larger auger, through the hollow shaft and along said exposed flighted extent of the smaller auger, to fill the bores made by the augers.

22. A method as in claim 21, wherein said supply of filler material is fed from a relatively fixed hopper means communicating with said hollow shaft of the larger auger, and the smaller auger is selectively rotatable in reverse directions for conveying material along flighting thereof correspondingly from and toward the relatively fixed hopper.

23. A method as for providing in an earth situs, a column of structural formation different from that of the situs, comprising the steps of: screwing a hollow-shafted auger into the situs while simultaneously rotating a relatively smaller, flighted auger within the hollow shaft of the larger auger to present a flighted extent of the smaller auger beyond the inner end of the larger auger, thereby to drill a second bore into the situs ahead the larger auger; and progressively withdrawing the larger auger while rotating said smaller auger within the hollow shaft to convey bore filler material, from a supply thereof at the upper end of the larger auger, through the hollow shaft to fill the bores made by the augers; said supply of filler material being fed from a relatively fixed hopper means communicating with said hollow shaft of the larger auger, and the smaller auger being selectively rotatable in reverse directions for conveying material along flighting thereof correspondingly from and toward the relatively fixed hopper; a second filler material from a source of supply being simultaneously fed downwardly through a passage in the smaller auger to outlet means thereon disposed within the drilled bore for blending convergence therein with the bore filling material conveyed through said hollow shaft.

24. A method as for providing in an earth situs, a column of structural formation different from that of the situs, comprising the steps of: screwing a hollow-shafted auger into the situs while simultaneously rotating a relatively smaller, flighted auger within the hollow shaft of the larger auger to present a flighted extent of the smaller auger beyond the inner end of the larger auger, thereby to drill a second bore into the situs ahead the larger auger; and progressively withdrawing the larger auger while rotating said smaller auger within the hollow shaft to convey bore filler material, from a supply thereof at the upper end of the larger auger, through the hollow shaft to fill the bores made by the augers; a second filler material from a source of supply being simultaneously fed downwardly through a passage in the smaller auger to an outlet disposed within the drilled bore below the larger auger for blending convergence with the bore-filling material conveyed through said hollow shaft, and wherein the separately fed materials include a granular substance and hardenable fluid grout forming a concrete pile in the bore.

25. A method of providing a supporting column in an earth situs, comprising the steps of: screwing a hollow-shafted, spiral-flight auger axially into the situs to define a cavity of predetermined depth while selectively maintaining a closure member at the inner end of the hollow shaft; withdrawing said closure member through said hollow shaft at a selective said predetermined depth of cavity and thereafter positioning elongated rigid means downwardly through the hollow shaft to be centrally of the defined cavity; and while withdrawing the auger from the situs, progressively feeding pressurized self-hardenable columnar material through said hollow shaft to

compress the same within the confines of the cavity walls beneath the auger, and thereby to surround and retain the rigid means centrally within the resultant formed column.

26. Apparatus as for providing in a situs of earth formation a core of different material, comprising vertically movable carriage means; a relatively large hollow-shafted, continuous flight auger rotatably carried by said carriage means for drilling movement into and out of the situs; means on said carriage means for rotating said hollow-shafted auger; a smaller continuous flight auger mounted on said carriage means and having means for rotatably and reciprocally mounting the same in the hollow shaft of the larger auger; a hopper non-rotatably mounted on said carriage means to be vertically movable therewith for supplying bore-filling material to said hollow shaft; access means on said hopper for supplying bore-filling material to said hopper while said hollow-shafted auger is rotating or stationary; said carriage means including releasably attached parts, releasable to be relatively movable for axially shifting said smaller auger within said hollow shaft; said rotation of said smaller auger within said hollow shaft being operable to force-feed material from said hopper inwardly through the hollow shaft and into a bore drilled in the situs; and closure means operable by axial shifting of said smaller auger for selectively controlling passage of the force fed material from said hollow shaft into the drilled bore.

27. Apparatus as in claim 26, said hopper being mounted on a said releasably attached part of said carriage means to be moveable therewith for said axial shifting of the smaller auger within said hollow shaft.

28. A method for providing in a situs of earth formation a core of different material, comprising: the steps of progressively screwing a hollow-shafted auger into the situs to form a hollow bore of selected depth, and rotating a relatively smaller flighted auger, rotatably and axially shiftably mounted within the hollow shaft of the larger auger, while projecting and exposing a substantial flighted extent of the smaller auger beyond the inner end of the larger auger, and withdrawing said larger auger from the formed hollow bore while selectively rotating said smaller auger within the hollow shaft to convey filler material, from a supply thereof at the upper end of the larger auger, through the hollow shaft and along the inwardly exposed flighted extent of the smaller auger progressively to fill the hollow bore with filler material.

29. Apparatus for providing in a situs of earth formation a core of a different material, comprising: a hollow-shafted, continuous flight auger having inner and outer ends; means for rotating and urging said hollow-shafted auger into said earth formation to form a hollow bore therein; supply means for supplying a said different material inwardly through said hollow shaft; an elongated shaft axially reciprocally mounted in the hollow shaft of said auger; said elongated shaft having thereon a closure located adjacent the inner end of said hollow shaft and axially movable therewith between closed and open positions; means selectively operable for axially shifting said elongated shaft toward and from the open position of said closure for passage of material from said supply means inwardly through the hollow shaft and into a said bore formed in the situs.

30. Apparatus as for providing in a situs of earth formation a core of a different material, comprising: vertically movable carriage means; a hollow-shafted, continuous flight auger rotatably carried by said carriage means for drilling movement into and out of the situs; means on said carriage means for rotating said hollow-shafted auger; an elongated shaft reciprocally mounted on said carriage means and having means for reciprocally mounting the same in the hollow shaft of the auger, said elongated shaft having a closure thereon adjacent the inner end of said hollow shaft; a hopper non-rotatably mounted on said carriage means to be vertically movable therewith for supplying bore-filling material to said shaft; access means on said hopper for supplying bore-filling material to said hopper while said hollow-shafted auger is rotating or stationary; said carriage means including

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releasably attached parts, releasable to be relatively movable for axially shifting said elongated shaft within said hollow shaft from and toward an open position of said closure for passage of material from said hopper inwardly through the hollow shaft and into a bore drilled in the situs.

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31. Apparatus as in claim 30, said hopper being mounted on said releasably attached part of said carriage means to be movable therewith for said axial shifting of said elongated shaft.

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