Nov. 2, 1954 P. C. DARIN ET AL 2,693,343

APPARATUS FOR DIGGING HOLES

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FIG.1.

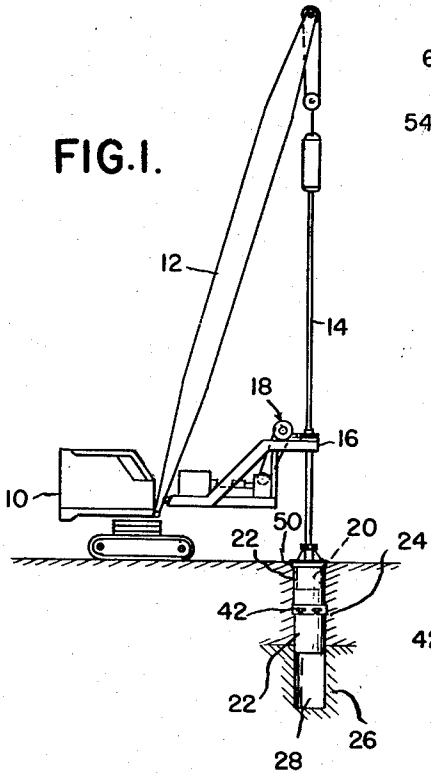



FIG.2.

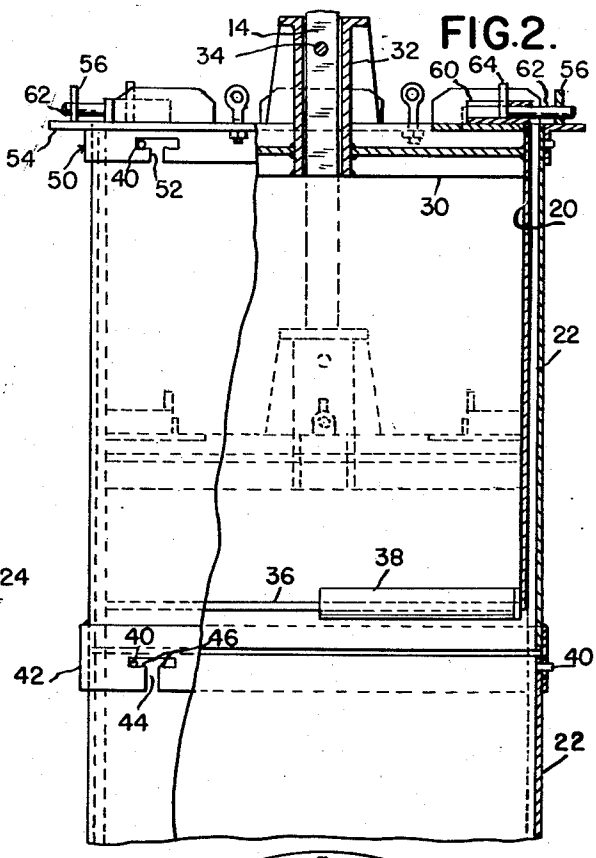
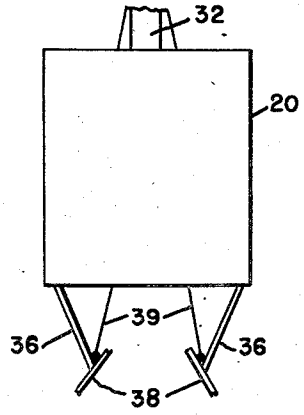



FIG.2A.



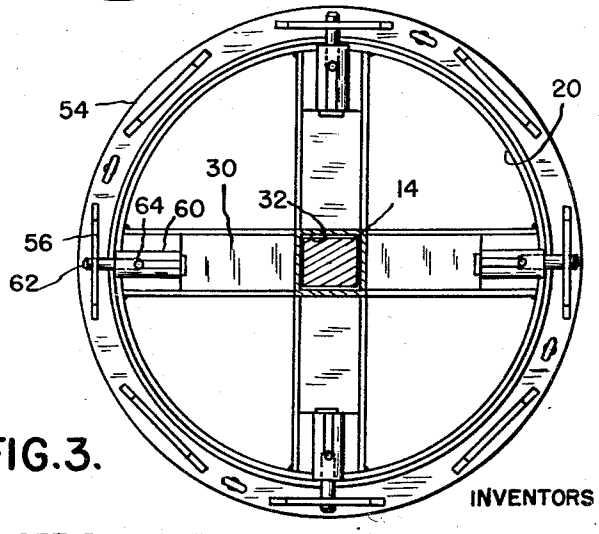




FIG.3.

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FIG.4.

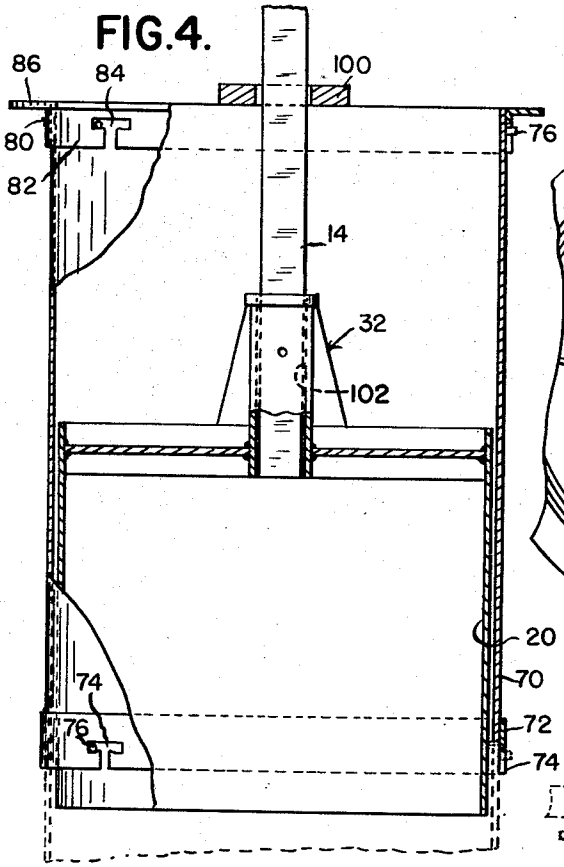



FIG.5.

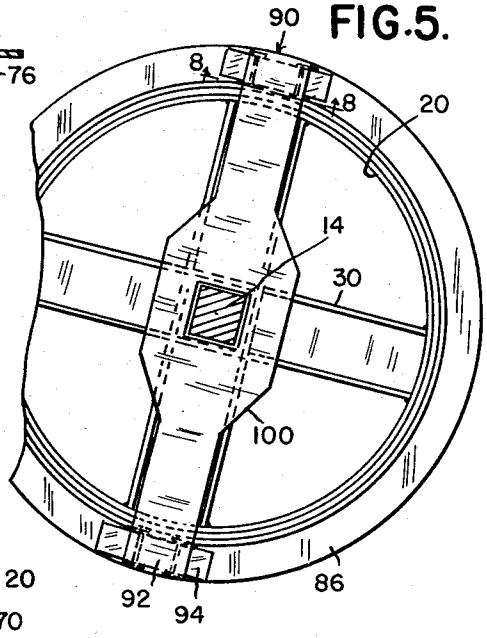



FIG.7.

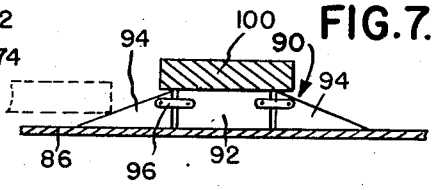



FIG.6.

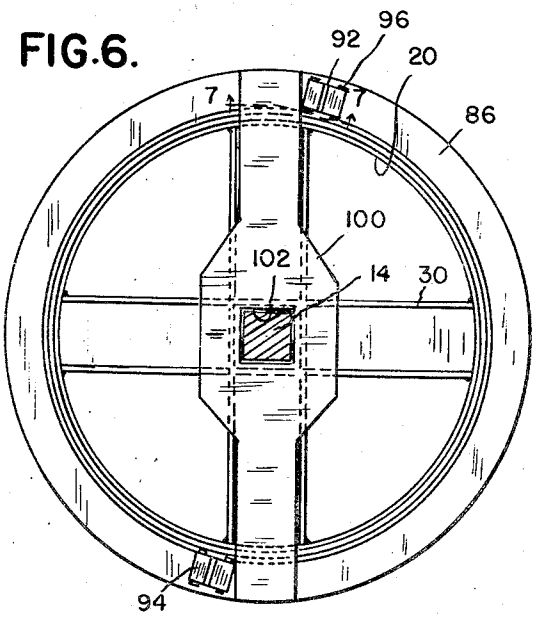



FIG.8.

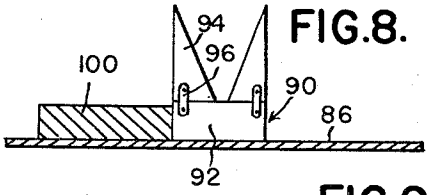
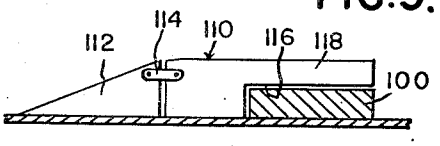



FIG.9.




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# APPARATUS FOR DIGGING HOLES

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Application February 1, 1951, Serial No. 208,873

10 Claims. (Cl. 255—19)

The present invention relates to apparatus for digging holes and more particularly to a construction for placing a caisson in position to intercept surface or subterranean water or loose earth, mud or the like to permit digging or drilling a hole through and beneath such material.

It is an object of the present invention to provide a caisson construction in combination with a hole digging bucket such that the bucket may be employed in placing the caisson at desired elevation, after which the bucket and caisson may be separated so that the bucket may pass through the caisson to continue the hole digging operation.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a side elevation of a hole digging apparatus showing the drilling mechanism in position in the earth.

Figure 2 is an enlarged side elevation of the drilling bucket and caisson combined with parts broken away.

Figure 2A is an elevational view of the boring bucket showing its dump doors partially open.

Figure 3 is a plan view of the structure shown in Figure 2, partly in section.

Figure 4 is a side elevation of a bucket-caisson combination of modified construction, with parts broken away.

Figure 5 is a plan view of the combination shown in Figure 4, partly in section.

Figure 6 is a view similar to Figure 5 illustrating the parts in different relationship.

Figure 7 is a section on the line 7—7, Figure 6.

Figure 8 is a section on the line 8—8, Figure 5.

Figure 9 is a view similar to Figure 8 showing a modified construction.

In construction work it is desirable in many cases to drill or bore holes to a firm footing and to fill these holes with concrete to support the foundations of the building. In many cases the problem of drilling or boring these holes is complicated by the presence of surface water or mud or loose earth. In other cases, the drilling operation may be rendered difficult by a layer or stratum of similar material encountered beneath the surface of earth.

According to the present invention a caisson or plurality of caissons are provided which may be positioned so as to intercept the surface water or other material and prevent it from draining into the hole.

Referring now to Figure 1 there is illustrated a boring machine comprising a prime mover 10 having a boom 12 from which is suspended a drive shaft 14. The drive shaft 14 passes through a platform 16 where means indicated generally at 18 are provided for effecting rotation of the drive shaft 14. For this purpose the drive shaft 14 is preferably non-circular in cross section and may conveniently be square. At the lower end of the drive shaft or kelly 14 is a boring bucket 20 and according to the present invention this bucket is associated with one or more caisson sections 22. In Figure 1 two such caisson sections are shown in assembled relationship. In this figure it is assumed that the stratum indicated at 24 is water, mud or other loose material through which it is impossible to dig a hole, the walls of which will be self-sustaining. At 26 there is indicated a firmer stratum in which digging may be carried out in the usual manner.

In digging the hole 28 the caisson sections 22 are positioned to prevent movement of water, mud or other loose material into the hole and the manner of placement thereof will now be described.



Referring now to Figures 2 and 3 the drilling bucket 20 is rigidly tied to the drive shaft or kelly 14 through a spider or cross arms 30 which carry a collar or sleeve 32 of square cross section in which the lower end of the shaft 14 is received. The shaft 14 is releasably retained therein by a pin 34. The bucket 20 has at its lower end a pair of hinged dump doors, one of which is indicated at 36. Each of these doors is provided at one side thereof with a cutting blade 38 disposed to cut into the earth and to force cut earth upwardly into the bucket upon rotation of the bucket in the proper direction. For a more complete description of this detail of construction attention is directed to Darin Patent 2,631,013 granted March 10, 1953. In Figure 2A the bucket is illustrated separately and shows the hinged dump doors in partly open position. Suitable means for opening and closing the dump doors are provided and are indicated in this figure as cables 39.

The caisson sections 22 are each provided adjacent their upper ends with a plurality of outwardly radially projecting coupling lugs 40. At their lower edge each of the coupling sections has rigidly secured thereto as by welding or the like, an annular collar 42 of a size sufficient to slip over the upper edge of another caisson section. The collar or ring 42 is provided with a plurality of bayonet notches 44, arranged to receive the lugs 40 to effect coupling between the caisson sections. Preferably, the bayonet slots include slightly projecting portions 46 forming a constriction in the laterally extending portion of the slot. The constriction is designed such that passage of the lug 40 to the extremity of the slot requires the exertion of substantial force and thus tends to operate as a latch preventing accidental separation between assembled caisson sections.

The uppermost caisson section of an assembly is provided with a ring or collar 50 which is L-shaped in cross section. The cylindrically extending lower portion is provided with a plurality of bayonet slots 52 identical with the bayonet slots 44 provided in the ring 42. They are adapted to cooperate with the lugs 40 previously referred to, to detachably assemble the ring 50 to the upper edge of the uppermost of an assembly of caisson sections. Alternatively, if a single caisson section will suffice in a particular operation, the ring 50 is provided at its top as indicated in Figure 2.

The flat radially outwardly extending portion 54 of the collar or ring 50 is provided with a plurality of upstanding ears 56, each of which is provided in turn with a pin receiving aperture.

Mounted on the cross pieces 30 which tie the bucket 20 to the drive shaft 14, are mountings 60 forming a guide for radially slidable coupling pins 62. The coupling pins 62 each include an upstanding finger 64 by means of which the pins may be projected outwardly to pass through the apertures in the ears 56 so as to effect a rigid coupling between the bucket 20 and the caisson section 22, and hence between the drive shaft 14 and the caisson section 22.

In operation the required number of caisson sections may be assembled together by fitting the lower coupling rings 42 over the upper edges of adjacent caisson sections. The ring 50 is attached to the upper section by engaging lugs 40 in slots 52. Thereafter, the drilling or boring bucket 20 may be lowered into the upper open end of the assembled caisson sections to the position shown in full lines in Figure 2. At this time assembly between the parts is completed by moving the coupling pins 62 outwardly to pass through the apertures provided in the ears 56. Thereafter the entire assembly including the assembled caisson sections and the boring bucket, may be moved by the prime mover to the proper position and lowered into place. At this time rotation is imparted to the drive shaft 14. So long as the lower edge of the lowermost caisson section is in water, loose sand, mud, soft earth, muck or the like, the caisson sections may be moved downwardly without difficulty. As soon as the lower edge of the lowermost caisson section encounters a firm stratum, the rotation of the caisson sections will result in causing the lower edge of the lowermost caisson section to sink into the firm stratum for a distance sufficient to effect the requisite sealing action to prevent entry of water, mud, etc., into a hole subse-

quently to be drilled in the firm stratum. At this time the pins 62 are moved radially inwardly so as to disengage the bucket from the assembled caisson sections. Thereafter, the bucket 20 may be lowered through the assembled caisson sections in its usual digging operation, which may be continued beyond the lower end of the lowermost caisson section to the required extent.

Referring now to Figures 4–8 there is illustrated a modified construction. In this case the drilling bucket 20 is illustrated as tied to the drive shaft 14 through cross pieces or spiders 30 as in the previous embodiment. Also, the caisson sections which in this embodiment of the invention are indicated at 70, are provided at their lower edge with coupling rings 72 having bayonet slots 74 therein adapted to receive lugs 76 carried adjacent the upper ends of the caisson sections. In this embodiment of the invention, a ring 80 is detachably secured to the upper end of the uppermost caisson section, the ring 80 having a cylindrical flange 82 provided with bayonet slots 84 for the reception of the lugs 76. The rings 80 are also provided with a flat outwardly extending flange 86 on which are mounted selectively operable drive devices indicated generally at 90 and illustrated in detail in Figures 7 and 8. These drive devices comprise rigid drive blocks 92 welded or otherwise firmly secured to the flange 86. At one or both sides of the blocks 92 are provided movable cam blocks 94, hinge means being indicated at 96 for connecting the cam blocks 94 to the rigid drive blocks 92.

Slidably mounted on the drive shaft 14 is a rigid drive bar 100 having a square opening 102 therethrough surrounding the square drive shaft 14. The bar 100 is preferably relatively heavy and is urged downwardly by gravity into contact with the flange 86 of the ring 80. The bucket 20 is freely movable through the caisson section 70 and upon upward movement of the bucket from the position indicated in Figure 4, the bucket or coupling collar 32 will eventually engage the bar 100 and raise the bar upwardly out of contact with the flange 86. However, when the bucket is moved downwardly inside of the caisson section the driving bar 100 rests upon the flange 86 in the manner previously described. If now, rotation is imparted to the driving bar 100 in a given direction, and the cam block 94 is elevated to the position illustrated in Figure 8, it will be apparent that the drive bar 100 will engage the rigid block 92 or the cam block 94 or both, and will effect rotation of the caisson section. This rotation of the caisson section when it is located in the desired position, will cause the caisson section to sink through the soft earth and into the lower firm stratum for a distance sufficient to effect the desired seal. After the caisson section has been sunk to its desired position the drive shaft 14 may be reversed slightly and the block 94 lowered to the full line position shown in Figure 7. Thereafter, while the drive bar 100 will continue to rest and rotate upon the flange 86, it will not effect rotation of the caisson section since it will ride up over the cam block 94 and the block 92.

In Figures 7 and 8 cam blocks 94 have been disclosed as provided at both sides of the rigid block 92 so that the drilling operation may be carried out in either direction. Actually of course, a particular bucket is designed to drill only in one direction so that if desired one of the cam blocks 94 may be omitted.

In Figure 9 there is illustrated a slight modification of the construction illustrated in Figures 4 through 8. In this embodiment of the invention a stationary block 110 is provided having associated therewith a cam block 112 pivoted as indicated at 114 to operate substantially in the same manner as the blocks 92 and 94 previously described. However, the opposite end of the stationary block 110 is undercut as indicated at 116 to provide a supporting projection 118 beneath which the ends of the bar 100 may enter. With this construction it is possible to position the bar 100 beneath the projection 118 so that the caisson section or sections may be lifted by lifting the drive shaft 14 and bucket 20. In this case it will be apparent that when the collar 32 of the bucket engages the underside of the bar 100, the bar will be raised upon further upward movement of the drive shaft 14. Since at this time the ends of the bar 100 are located under the projection 118, the caisson section or sections will simultaneously be lifted. This permits preliminary assembly of the caisson sections at a point remote from the location of the hole to be dug. After the caisson sections are assembled (if more than one is to be used) the bucket may be lowered into the upper open end of the assembled caisson sections to a point permitting the bar 100 to rest upon the flange 86. At this time the shaft 14 may be reversely rotated to bring the ends of the bar 100 beneath the projections 118, or the caisson sections may be manually rotated if preferred to effect the interlocked position illustrated in Figure 9.



Thereafter, the prime mover may be moved to operating position or the boom 12 may be moved by swinging the cab of the prime mover, thus moving the assembled bucket and caisson sections to proper position. Thereafter the bucket and caisson sections may be lowered until the lower edge of the caisson section is arrested. Thereafter rotation of the shaft 14 will cause the bar 100 to move outwardly from beneath the projection 118. The cam block 112 will be positioned upwardly at this time and as the ends of the bar 100 come into engagement with the rigid drive block 110, rotation will be imparted to the caisson section or sections. Again, after the caisson section or sections have been sunk a desired depth into the firm underlying stratum, the drive shaft 14 and bar 100 may be backed up slightly and the cam block 112 lowered to the position illustrated in Figure 9. Thereafter the earth boring operation may be carried out in the usual manner through the assembled caisson sections.

The lower edge of the bucket may thus be lower than the lower edge of the lowermost caisson section so as to precede the caisson into the firm lower stratum, and thus facilitate entry of the caisson section into the firm stratum. If required by the nature of the firm lower stratum, the lower edge of the caisson sections may be serrated to enable them to cut their way into the stratum.

In any of the foregoing embodiments, the caisson and bucket assembly may be lowered into loose and flowing mud or the like, in which case the caisson may sink initially to a depth in which the fluent material will enter the bucket. This material may then be removed by elevating the bucket, leaving the caisson in an intermediate position, and thereafter again lowering the bucket and engaging it with the caisson for a further combined caisson-sinking earth removing operation. Alternatively, the apparatus may be employed in the following manner: The bucket may be attached to a single caisson section or the uppermost of a plurality of caisson sections and the entire assembly lowered until the bottom edge of the bottom caisson section is more or less firmly seated in relatively solid material. At this time, assuming that this solid material is overlaid by water, soft mud or the like, the caisson section or assembly of sections may be more or less completely filled with water, soft mud or other fluent material which will rise into the caisson assembly as they are lowered. After the bottom edge of the bottom caisson section is relatively firmly seated and embedded in solid material, the bucket may be released from the top edge of the caisson section or sections and lowered while being rotated through the caisson structure. If the material within the caisson is relatively fluent, the material will enter the bucket and the bucket may be lowered down into contact with the relatively solid material at the bottom of the caisson structure, at which time it may be well beneath the surface of the fluent material within the caisson structure. At this time if the bucket is rotated and further lowered it will bore into the solid material and will force relatively solid material into the bucket where it will form a seal. Thereafter, if the bucket is elevated, the relatively solid material in the bucket will prevent a flow of relatively fluent material out of the bucket and the bucket will operate more or less as a piston, forcing water and/or fluent material out of the top of the caisson structure. The bucket may be elevated completely out of the caisson structure and swung to one side and dumped by opening the bottom dump doors.

If a certain amount of water and/or fluent material remains in the caisson structure the operation may be repeated, even to the point where relatively solid material may be removed from below the bottom edge of the caisson structure. If necessary, following this operation, the bucket may be re-attached to the caisson structure and the structure rotated together with the bucket and forced further into the relatively solid material. after

which any fluent material may be removed by repeating a further boring operation with the bucket and removal of the bucket upwardly through the open top of the caisson structure.

The drawings and the foregoing specification constitute a description of the improved apparatus for digging holes in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What we claim as our invention is:

1. A plurality of like caisson sections adapted to cooperate with and permit passage therethrough of a boring bucket having bottom dump doors, each caisson section provided with radially outwardly projecting lugs adjacent its upper edge, and a ring at its lower edge having slots therein for detachably engaging the lugs of another section, a detachable ring having slots therein for detachably engaging the lugs at the top of the uppermost of an assembly of sections, and means on said detachable ring engageable with releasable latch means at the top of the boring bucket.

2. Hole digging apparatus comprising a rotary boring bucket having bottom dump doors, a rigid drive shaft connected to said bucket and extending upwardly therefrom, a caisson of slightly larger diameter than said bucket and slidable thereover, a driving bar on said shaft overlying the upper edge of said caisson and movable vertically on said shaft, movable blocks on the upper edge of said caisson engageable by said bar, said blocks being movable between a driving position in which they serve as abutments for engagement by said bar, and a non-driving position, in which the bar rides over said blocks.

3. Hole digging apparatus comprising a rotary boring bucket having bottom dump doors, a rigid drive shaft connected to said bucket and extending upwardly therefrom, a caisson of slightly larger diameter than said bucket and slidable thereover, a driving bar on said shaft overlying the upper edge of said caisson and movable vertically on said shaft, means on said caisson releasably engaging the ends of said bar to permit lifting and placement of said caisson by said bar, abutment means on said caisson to provide for rotation of said caisson by said bar, and means operable after placement of said caisson effective to prevent further rotation of said caisson.

4. A rotary vertical drive shaft, means for raising, lowering and rotating said drive shaft, a cylindrical boring bucket, means connecting said bucket to said drive shaft for raising, lowering and rotation thereby, bottom dump doors on said bucket, a cylindrical caisson having an internal diameter permitting passage of said bucket therethrough, a bar non-rotatably and vertically slidably mounted on said drive shaft, abutment means below said bar for raising said bar upon lifting of said bucket by said drive shaft, driving and lifting elements on the top of said caisson comprising hooks facing in the same circumferential direction beneath which said bar is engageable upon relative rotation between said caisson and bar in one direction, said elements having abutment surfaces facing in the opposite direction engageable with said bar upon relative rotation between said bar and caisson in the opposite direction.

5. Structure as defined in claim 4 comprising a movable cam associated with said elements having cam surfaces shaped to guide said bar upwardly and over the abutment surfaces of said elements in one position and to permit driving engagement between said bar and elements in a second position.

6. A caisson assembly for use with a rotary boring bucket provided with bottom dump doors and having a rigid drive shaft connected thereto for rotating, raising and lowering said bucket, said assembly comprising a plurality of like caisson sections each having releasable coupling structure at the top and bottom for establishing interconnection between said sections, a ring having a cylindrical flange provided with coupling structure identical with that provided at the bottom of each caisson section for connecting said ring to the top of the uppermost of a series of connected caisson sections, said ring having releasable coupling means thereon for connecting said ring to said bucket and shaft.



7. A rotary vertical drive shaft, means for raising, lowering and rotating said drive shaft, a cylindrical boring bucket, means connecting said bucket to said drive shaft for raising, lowering and rotation thereby, bottom dump doors on said bucket, a caisson assembly comprising a plurality of like caisson sections each having releasable coupling structure at the top and bottom for establishing interconnection between said sections, a ring having a cylindrical flange provided with coupling structure identical with that provided at the bottom of each caisson section for connecting said ring to the top of the uppermost of a series of connected caisson sections, and selectively engageable rigid connections between said ring and said bucket and shaft, said caisson sections having an internal diameter slightly larger than the outside diameter of said bucket to provide for vertical movement of said bucket in said caisson section.

8. Structure as defined in claim 7 in which said rigid connections are provided in part adjacent the top of said bucket whereby said bucket is located within said upper caisson section when said ring is connected to said bucket and shaft.

9. Structure as defined in claim 7 in which said coupling structure comprises bayonet slots and pins, and said bayonet slots include vertical portions and horizontal portions having pin engaging constrictions to constitute latch means preventing accidental separation between said pins and slots.

10. A rotary vertical drive shaft, means for raising, lowering and rotating said drive shaft, a cylindrical boring bucket, means connecting said bucket to said drive shaft for raising, lowering and rotation thereby, bottom dump doors on said bucket, a cylindrical caisson having an internal diameter only large enough for permitting passage of said bucket therethrough, selectively engageable connecting means located adjacent the top of said caisson and adjacent the top of said bucket for connecting said caisson to said bucket and drive shaft for rotation therewith and for raising and lowering thereby, said connecting means being selectively engageable and disengageable when said bucket is located in the upper part of said caisson with the tops of said bucket and caisson substantially in the same horizontal plane, said caisson being of a vertical height exceeding that of said bucket whereby when said bucket and caisson are lowered into contact with the ground, said caisson sinks into the ground ahead of said bucket, said bucket being releasable from said caisson to remove earth from the interior of said caisson and from beneath said caisson after said caisson has been sunk to a required depth.

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