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(54) A HOLE CUTTING DEVICE

(57) Devices for cutting holes in the ground typically have to be raised regularly to clear the debris from the hole. This is effected by a line attached to a bracket on the cutting assembly. However, the line can get wound around the rotating drive shaft which can be dangerous and prevent lifting of the assembly. Accordingly, a hole cutting device (10) is provided comprising: a first sleeve (25) for rotation by a drive member (20), the drive member (20) including a pilot hole cutting means (40) for creating a pilot hole having a first diameter; at least one first cutting member (160) linked to the first sleeve (25) for rotation thereof for cutting a hole having a second diameter larger than the first diameter; a bracket (140) for raising and lowering of the device (10) relative to the drive member (20); and anti-rotation means (90, 100) for maintaining the bracket (140) substantially rotationally stationary relative to the pilot hole; wherein the anti-rotation means comprises at least one ground engaging member (50) for engaging with a side (50) of the pilot hole.

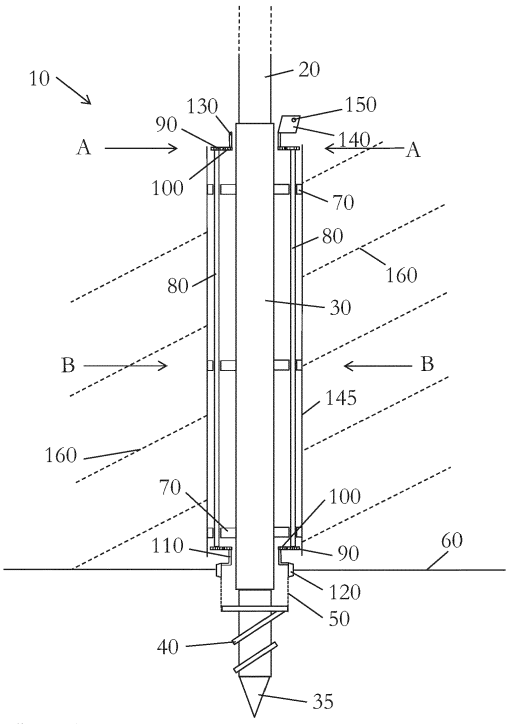

Figure 1

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Description

[0001] The present invention relates generally to a hole cutting device and a method of cutting a hole and finds particular, although not exclusive, utility in the augering of holes in the ground.

[0002] An auger typically comprises a spiral blade arranged on a drive shaft which is rotated to cut a hole. The debris or spoil arising from the cutting or boring operation has to be cleared from the hole. Accordingly, this is typically effected by lifting out the auger from the hole. This may include lifting out the drive shaft as well. However, it is undesirable to lift out the drive shaft in some situations such as sites with limited head room as it is time consuming to have to disassemble the drive shaft which typically comprises several uniformly short lengths attached to one another to form a longer length.

[0003] Consequently, other options have been devised. One method uses a cutting assembly which slides up and down the drive shaft. A bracket is attached to the top of the cutting assembly and a wire or cord ran down from the surface to the cutting assembly. When it is desire to lift up the cutting assembly, a winch located on the surface is used to wind-in the cord. However, the cord will become wrapped around the drive shaft as the cutting assembly rotates. To overcome this it is known to provide a rotation means for rotating the winch in synchronisation with the cutting assembly. This is relatively more expensive than without such a means and adds height to the equipment. The height of the equipment can be very important if it is to be used inside a building.

[0004] To solve this issue a lever has been provided to wedge the bracket against the side of the cut hole and to mount the bracket on a slip ring such that the drive shaft rotates but the bracket remains substantially stationary. However, this method has problems in that if the ground is wet and/or sandy the slip ring on which the bracket is mounted may cease to rotate relative to the drive shaft thus causing the cord to wind around the drive shaft again.

[0005] Sleeves may be used in such ground to stabilise it and therefore in US4,530,410 a device was proposed which biased the lever against a rib welded to the inside of the lowest, or one of the lowest, sleeves in the hole.

[0006] However, sleeves are relatively very expensive compared to not using sleeves and other ways are now known for stabilising the sides of holes while they are being cut such as the use of bentonite. Therefore it is desirable to have a device which can be used to raise and lower a cutting assembly into and out of a hole without increasing the head room required for the apparatus and which can be used with or without sleeved holes.

[0007] In a first aspect the invention provides a hole cutting device comprising: a first sleeve for rotation by a drive member, the drive member including a pilot hole cutting means for creating a pilot hole having a first diameter; at least one first cutting member linked to the first sleeve for rotation thereof for cutting a hole having a second diameter larger than the first diameter; a bracket for raising and lowering of the device relative to the drive member; and anti-rotation means for maintaining the bracket substantially rotationally stationary relative to the pilot hole; wherein the anti-rotation means comprises at least one ground engaging member for engaging with a side of the pilot hole.

[0008] In this way the bracket is maintained stationary relative to the drive member such that a cord attached to the bracket does not become wrapped around the drive member.

[0009] The pilot hole is typically below the hole cut by the first cutting member and the hole descends downwardly (below the horizontal). In this way, gravity is used to maintain the cutting members in contact with the ground to be cut.

[0010] The pilot hole cutting means may comprise a spike located at the extreme axial end of the drive means. Also, it may comprise an auger or other such cutting blade(s) located on the axial side of the drive member.

[0011] The pilot hole has a relatively small diameter and length and therefore its sides are typically more stable whatever the ground conditions. Therefore the use of the side of the pilot hole provides better ground engagement than the sides of the cut hole above.

[0012] The drive means may be a square section "Kelly bar".

[0013] The at least one ground engaging member may be mounted on a first ring which is rotatably mounted on the inner sleeve. The mounting of the first ring on the inner sleeve may be direct or indirect via another sleeve and/or arm.

[0014] The bracket may be mounted on a second ring which is rotatably mounted on the inner sleeve. The mounting of the second ring on the inner sleeve may be direct or indirect via another sleeve and/or arm.

[0015] The second ring may be arranged axially on the other side of the first cutting member from the first ring. In other words, the second ring may be located above the first ring with the first cutting member located therebetween.

[0016] The anti-rotation means may further comprise at least one rotatable shaft for transferring the rotation of the first ring, relative to the inner sleeve, to the second ring. The at least one rotatable shaft may orbit the drive member, in use. The at least one rotatable shaft may be located radially inward of the first and second rings.

[0017] This transfer may be effected by providing complementary surfaces on the first and second rings and rotatable shaft. For instance, the surfaces may be relatively smooth but having a relatively high component of friction, such as rubber.

[0018] Alternatively, the first and second rings may include teeth on their inner and/or outer surfaces, and the at least one rotatable shaft may include two sets of teeth on its outer surface each for engagement with the teeth of the first and second rings.

[0019] In this manner, the first ring may cause the shaft

to rotate relative to the drive member thus causing the second ring to rotate relative to the drive member, such that the first and second rings have synchronised rotation relative to the drive member. Accordingly, the ground engaging members keep the second ring stationary relative to the hole so that the bracket also remains substantially stationary therefore leading to no winding of the cord around the drive member.

[0020] The hole cutting device may further comprise biasing means for biasing the at least one ground engaging member towards the side of the pilot hole. The biasing means may be a spring. The at least one ground engaging member may include a ground penetrating member such as a fin, tooth or spike.

[0021] The at least one cutting member may be linked to the first sleeve via an outer sleeve. This outer sleeve may be located radially outward of the at least one rotatable shaft and the inner sleeve and first ring. Alternatively, the outer sleeve may be located radially inward of the at least one rotatable shaft.

[0022] The outer sleeve may be supported on the inner sleeve by at least one arm. The arm may orbit the drive member in synchronisation with the at last one rotational shaft such that the two do not impeded one another.

[0023] The at least one arm may also support the at least one rotatable shaft.

[0024] The first cutting member may be an auger, although other forms are contemplated.

[0025] Ground engaging control means may be provided for controlling the position of the at least one ground engaging member. For instance, to retract or extend the ground engaging member. The control means may be provided by wireless, or wired means and may include an actuator.

[0026] In a second aspect, the invention provides a method of cutting a hole comprising the steps of: providing a hole cutting device according to the first aspect; rotating the drive means to rotate the pilot hole cutting means to cut a pilot hole having a first diameter; engaging the sides of the pilot hole with the at least one ground engaging member; rotating the drive means to rotate the first cutting member to cut a hole having a second diameter larger than the first diameter; and pulling the device out of the cut hole using the bracket so as to remove the debris produced by the cutting of the holes.

[0027] The rotation of the pilot hole cutting means and first cutting means may occur simultaneously. The drive means may be rotated by an engine located at the surface above the hole. The drive means may be stopped from rotation before the device is raised upward in the hole.

[0028] Once the debris has been lifted out of the hole the device may be lowered back into the hole and the drive means restarted such that the depth of the hole increases incrementally. In some ground conditions the first cutting member is only rotated a few rotations (in the range 3 to 12) before being raised.

[0029] The auger may only cut 300mm of hole depth before being raised. The holes may be cut having a second diameter of up to approximately one metre and may extend to a depth of approximately 100 metres.

[0030] The above and other characteristics, features and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. This description is given for the sake of example only, without limiting the scope of the invention. The reference figures quoted below refer to the attached drawings.

Figure 1 is schematic side view of a first version of a hole cutting device;

Figure 2 is a cross-sectional view along A-A in Figure 1;

Figure 3 is a cross-sectional view along B-B in Figure 1;

Figure 4 is schematic side view of a second version of a hole cutting device;

Figure 5 is a cross-sectional view along C-C in Figure 4;

Figure 6 is a cross-sectional view along D-D in Figure 4;

[0031] The present invention will be described with respect to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. Each drawing may not include all of the features of the invention and therefore should not necessarily be considered to be an embodiment of the invention. In the drawings, the size of some of the elements may be exaggerated and not drawn to scale for illustrative purposes. The dimensions and the relative dimensions do not correspond to actual reductions to practice of the invention.

[0032] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequence, either temporally, spatially, in ranking or in any other manner. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that operation is capable in other sequences than described or illustrated herein.

[0033] Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that operation is capable in other orientations than described or illustrated herein.

[0034] It is to be noticed that the term "comprising", used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. It is thus to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the presence or addition of one or more other

features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

[0035] Reference throughout this specification to "an embodiment" or "an aspect" means that a particular feature, structure or characteristic described in connection with the embodiment or aspect is included in at least one embodiment or aspect of the present invention. Thus, appearances of the phrases "in one embodiment", "in an embodiment", or "in an aspect" in various places throughout this specification are not necessarily all referring to the same embodiment or aspect, but may refer to different embodiments or aspects. Furthermore, the particular features, structures or characteristics of any embodiment or aspect of the invention may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art from this disclosure, in one or more embodiments or aspects.

[0036] Similarly, it should be appreciated that in the description various features of the invention are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Moreover, the description of any individual drawing or aspect should not necessarily be considered to be an embodiment of the invention. Rather, as the following claims reflect, inventive aspects lie in fewer than all features of a single foregoing disclosed embodiment. Thus, the claims following the detailed description are hereby expressly incorporated into this detailed description, with each claim standing on its own as a separate embodiment of this invention.

[0037] Furthermore, while some embodiments described herein include some features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the invention, and form yet further embodiments, as will be understood by those skilled in the art. For example, in the following claims, any of the claimed embodiments can be used in any combination.

[0038] In the description provided herein, numerous specific details are set forth. However, it is understood that embodiments of the invention may be practised without these specific details. In other instances, well-known methods, structures and techniques have not been shown in detail in order not to obscure an understanding of this description.

[0039] In the discussion of the invention, unless stated to the contrary, the disclosure of alternative values for the upper or lower limit of the permitted range of a parameter, coupled with an indication that one of said values is more highly preferred than the other, is to be construed as an implied statement that each intermediate value of said parameter, lying between the more preferred and the less preferred of said alternatives, is itself preferred to said less preferred value and also to each value lying between said less preferred value and said intermediate value.

[0040] The use of the term "at least one" may mean only one in certain circumstances.

[0041] The principles of the invention will now be described by a detailed description of at least one drawing relating to exemplary features of the invention. It is clear that other arrangements can be configured according to the knowledge of persons skilled in the art without departing from the underlying concept or technical teaching of the invention, the invention being limited only by the terms of the appended claims.

[0042] In Figure 1 a hole cutting device 10 is shown in elevation. It is driven by a Kelly Bar 20 (a square-section bar) which extends linearly down the hole as the hole length is increased. The Kelly Bar 20 fits inside a correspondingly square shape inner sleeve 25 (refer to Figure 2) such that its rotation also rotates the inner sleeve 25.

[0043] At the distal (lowest) end of the Kelly Bar 20 a relatively sharp point 35 is provided for engaging with the ground 60 to be excavated. A small auger-like structure 40 is provided behind (above) the point 35 such that rotation of the Kelly Bar 20 rotates this auger-like structure to create a pilot hole having side 50 defining a relatively small diameter (in the range 5 to 20cm).

[0044] With reference to Figure 2, which is a cross-sectional plan view across the diameter of the device 10 in the plane referenced 'A-A' in Figure 1, the inner sleeve 25 is shown as square shape. An inner sleeve cover 30 is also shown. This has a circular shape in plan and is connected to the inner sleeve 25 such that it rotates with the inner sleeve 25. This cover 30 is not essential and therefore all references to connections or attachments to the inner sleeve 25 also refer to the inner sleeve cover 30.

[0045] In Figure 1, arms 70 extend from the inner sleeve 25 radially outward. These arms include shaft 80 retaining apertures 85 (refer to Figure 3) for retaining shafts 80 which extend linearly along the length of the device parallel to the Kelly Bar 20. These shafts 80 connect upper and lower cogs 90 which are located at each end of the each shaft 80. Although only two shafts 80 are shown it is contemplated that the quantity of shafts may be more or less than this number.

[0046] At the lower end of the device 10, the teeth on the cogs 90 engage with corresponding teeth provided on the outside of an inner cog 100 provided radially outside of the inner sleeve 25 and radially inside of the cogs 90. The inner cog 100 sits around the inner sleeve 25 but is rotationally independent from it such that it does not rotate with the rotation of the inner sleeve 25.

[0047] Depending from this inner cog 100 arms 110 are arranged which support fins 120. These fins 120

project into the sides 50 of the pilot hole cut by the small auger-like structure 40 at the base end of the Kelly Bar 20. These fins 120 may be spring-loaded to bias them against the side walls 50. In this manner, the fins remain stationary relative to the pilot hole. The inner cog 100 also remains stationary relative to the pilot hole due to it being connected to the fins 120.

[0048] However, the shafts 80 rotate with the inner sleeve 25 and due to the interaction of the teeth on the cogs 90 and the inner cog 100 these shafts rotate about their own axis. In other words the shafts orbit the Kelly Bar 20 such that they rotate about their own axes and about the axis of the Kelly Bar 20.

[0049] In this manner, the rotation of the cogs 90 at the lower end of the device 10 will rotate the cogs 90 at the upper end of the device 10. The rotation of these upper cogs 90 will rotate relatively the inner cog 100 located at the upper end of the device such that this inner cog 100 will remain stationary relative to the pilot hole.

[0050] Attached to the upper inner cog 100 is an arm 130 extending upwardly supporting a bracket 140 which includes a hole 150 for attachment to a wire or other cord-like element which extends down the hole from the surface.

[0051] As the upper inner cog 100 remains stationary relative to the hole being cut so does the bracket 140. In this way, the cord will not become wrapped around the Kelly Bar 20.

[0052] In Figure 1, the flights 160 forming the auger for cutting the main hole are indicated in broken lines. The angle, radius, axial separation and number of turns of these flights (cutting blade) may all be chosen as required depending on the ground conditions.

[0053] An outer sleeve 145 is shown in Figure 1 radially external of the shafts 80 and inner sleeve 25. The outer sleeve 145 is attached to the inner sleeve 25 by means of arms. In Figure 1 these arms 70 are the same arms that hold the shafts 80, however, different arms may be provided to do this.

[0054] This outer sleeve 145 is optional, however, its presence may be useful in keeping the cogs 90, 100 clear of debris from the hole.

[0055] Seals (not shown) may be provided between the inner cog 100 and the inner sleeve 25 (or inner sleeve cover 30) to prevent debris from affecting the ability of the inner cogs 100 to rotate relative to the inner sleeve 25 (or inner sleeve cover 30).

[0056] In Figure 2, a plan cross-sectional view of the device 10 at a point indicated by "A-A" on Figure 1 is shown. The Kelly Bar 20 is seen as being a square, with the inner sleeve 25 located as a square around it. The inner sleeve cover 30 is a circular shape and extends around the inner sleeve 25. The inner cog 100 is located radially outside of this inner sleeve cover 30 and is rotationally independent from it. The inner sleeve cover 30 is optional.

[0057] The shafts 80, including the cogs 90 are visible, located diametrically opposite one another either side of the Kelly Bar 20. The outer sleeve 145 is located radially outside of these shafts 80 and cogs 90.

[0058] These drawings are not to scale and may vary from one Figure to another for the same feature.

[0059] In Figure 3, a plan cross-sectional view of the device 10 at a point indicated by "B-B" on Figure 1 is shown. The Kelly Bar 20 is seen as being a square, with the inner sleeve 25 located as a square around it. The inner sleeve cover 30 is a circular shape and extends around the inner sleeve 25. Two arms 70 extend from the inner sleeve cover 30 (although they may extend from the inner sleeve 25) to the outer sleeve 145. Within each arm 70 a hole 85 is arranged to receive the shaft 80. These holes may include bearings.

[0060] Figure 4 is an alternative device 210 which operates in a similar manner to that shown in Figure 1.

[0061] The device 210 includes a Kelly Bar 220, an inner sleeve 225, a sharp point 235 at the base of the Kelly Bar 220, an auger-like assembly behind the point 235 comprising a blade 240 for cutting a pilot hole having side walls 250.

[0062] Shafts 280 are held, such that they can rotate about their own axes, by arms 270 extending from the inner sleeve cover 230. Each shaft is axially behind (above) the sharp point 235 and parallel to the longitudinal axis of the Kelly Bar 220.

[0063] Fins 320 are resiliently biased into the side walls 250 of the pilot hole. Arms 310 extend from these fins to an outer cog 300 provided radially around the shafts 280. This outer cog 300 is mounted on the inner sleeve 225 but arranged to rotate relative to it. At the lower end of each shaft 280 a cog 290 is provided which engages with the teeth provided radially on the inner surface of the outer cog 300. Accordingly, as the inner sleeve 225 rotates the shafts 280 orbit the axis of the Kelly Bar 220 and also rotates about their own axes.

[0064] At the top of each shaft 280 another cog 290 is provided and another outer cog 300 is provided in a similar relationship as have the cogs 290 and outer cog 300 at the base of the device.

[0065] Attached to the outer cog 300 an arm 330 extends upwardly to a bracket 340 including a hole 350. The rotation of the shafts 280 ensures that this upper outer cog 300 remains stationary relative to the pilot hole and the rotating inner sleeve 225. Accordingly, any cord attached to the bracket 340 will not become wound around the Kelly Bar 220 in use.

[0066] In Figure 4, the flights 360 forming the auger for cutting the main hole are indicated in broken lines. The angle, radius, axial separation and number of turns of these flights (cutting blade) may all be chosen as required depending on the ground conditions.

[0067] An outer sleeve 345 is shown radially external of the shafts 280 and inner sleeve 225. This outer sleeve 345 is attached to the inner sleeve 225 by means of arms. In Figure 4 these arms 270 are the same arms that hold the shafts 280, however, different arms may be provided to do this.

[0068] This outer sleeve 345 is optional, however, its presence may be useful in keeping the cogs 290, 300 clear of debris from the hole.

[0069] Seals (not shown) may be provided between the outer cog 300 and the inner sleeve 225 to prevent debris from affecting the ability of the outer cogs 300 to rotate relative to the inner sleeve 225.

[0070] In Figure 5, a plan cross-sectional view of the device 210 at a point indicated by "C-C" on Figure 4 is shown. The Kelly Bar 220 is seen as being a square, with the inner sleeve 225 located as a square around it. The shafts 280, including the cogs 290 are visible, located diametrically opposite one another either side of the Kelly Bar 220 and radially outside of the inner sleeve 225. The outer sleeve 345 is located radially outside of these shafts 280 and cogs 290. The outer cog 300 is located radially outside of the shafts 280. Although an inner sleeve cover is not shown it will be understood that one could be arranged between the inner sleeve 225 and the outer cog 300.

[0071] These drawings are not to scale and may vary from one Figure to another for the same feature.

[0072] In Figure 6, a plan cross-sectional view of the device 210 at a point indicated by "D-D" on Figure 4 is shown. The Kelly Bar 220 is seen as being a square, with the inner sleeve 225 located as a square around it. Two arms 270 extend from the inner sleeve 225 to the outer sleeve 345. Within each arm 270 a hole 285 is arranged to receive the shaft 280. These holes may include bearings.

Claims

1. A hole cutting device comprising: a first sleeve for rotation by a drive member, the drive member including a pilot hole cutting means for creating a pilot hole having a first diameter; at least one first cutting member linked to the first sleeve for rotation thereof for cutting a hole having a second diameter larger than the first diameter; a bracket for raising and lowering of the device relative to the drive member; and anti-rotation means for maintaining the bracket substantially rotationally stationary relative to the pilot hole; wherein the anti-rotation means comprises at least one ground engaging member for engaging with a side of the pilot hole.

2. The hole cutting device according to claim 1, wherein the at least one ground engaging member is mounted on a first ring which is rotatably mounted on the inner sleeve.

3. The hole cutting device according to claim 2, wherein the bracket is mounted on a second ring which is rotatably mounted on the inner sleeve.

4. The hole cutting device according to claim 3, wherein the second ring is arranged axially on the other side of the first cutting member from the first ring.

5. The hole cutting device according to either one of claims 3 and 4, wherein the anti-rotation means further comprises at least one rotatable shaft for transferring the rotation of the first ring, relative to the inner sleeve, to the second ring.

6. The hole cutting device according to claim 5, wherein the first and second rings include teeth on their inner and/or outer surfaces, and the at least one rotatable shaft includes two sets of teeth on its outer surface each for engagement with the teeth of the first and second rings.

7. The hole cutting device according to any preceding claim, further comprising biasing means for biasing the at least one ground engaging member towards the side of the pilot hole.

8. The hole cutting device according to any preceding claim, wherein the at least one cutting member is linked to the first sleeve via an outer sleeve.

9. The hole cutting device according to claim 8, wherein the outer sleeve is supported on the inner sleeve by at least one arm.

10. The hole cutting device according to claim 9, when dependent directly or indirectly on claim 5, wherein the at least one arm also supports the at least one rotatable shaft.

11. The hole cutting device according to any preceding claim, wherein the first cutting member is an auger.

12. A method of cutting a hole comprising the steps of: providing a hole cutting device according claim 11; rotating the drive means to rotate the pilot hole cutting means to cut a pilot hole having a first diameter; engaging the sides of the pilot hole with the at least one ground engaging member; rotating the drive means to rotate the first cutting member to cut a hole having a second diameter larger than the first diameter; and pulling the device out of the cut hole using the bracket so as to remove the debris produced by the cutting of the holes.

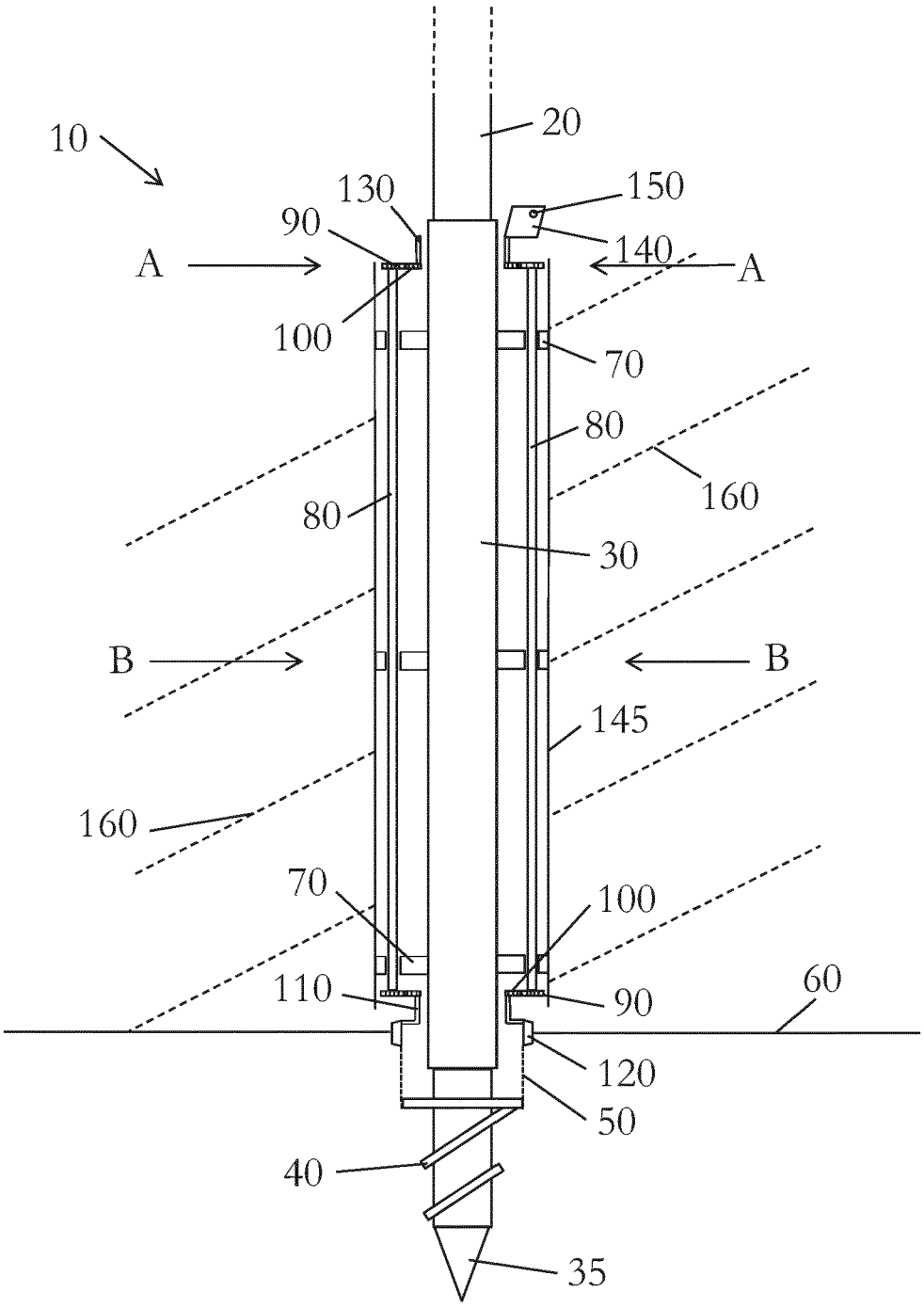
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Figure 1

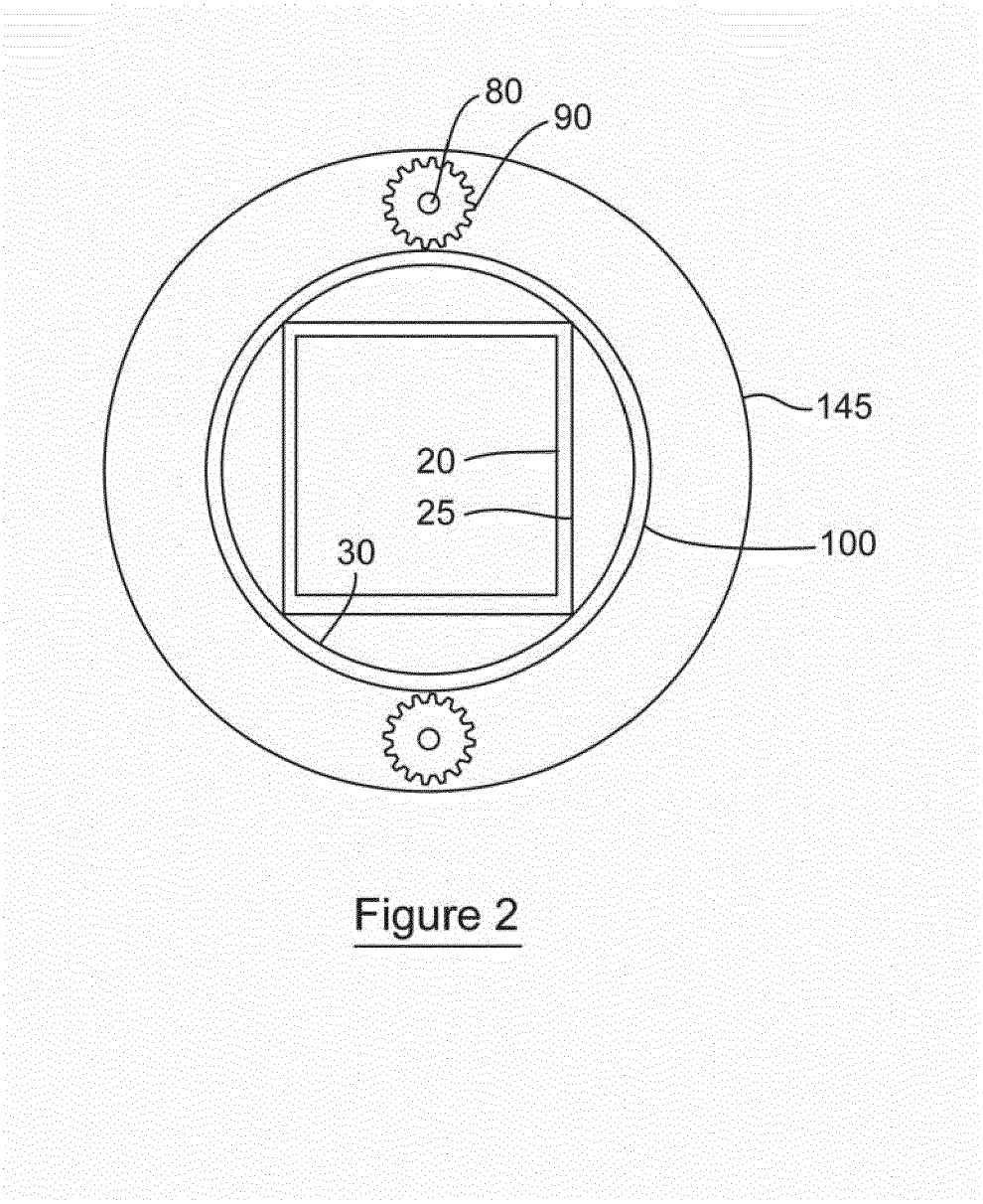
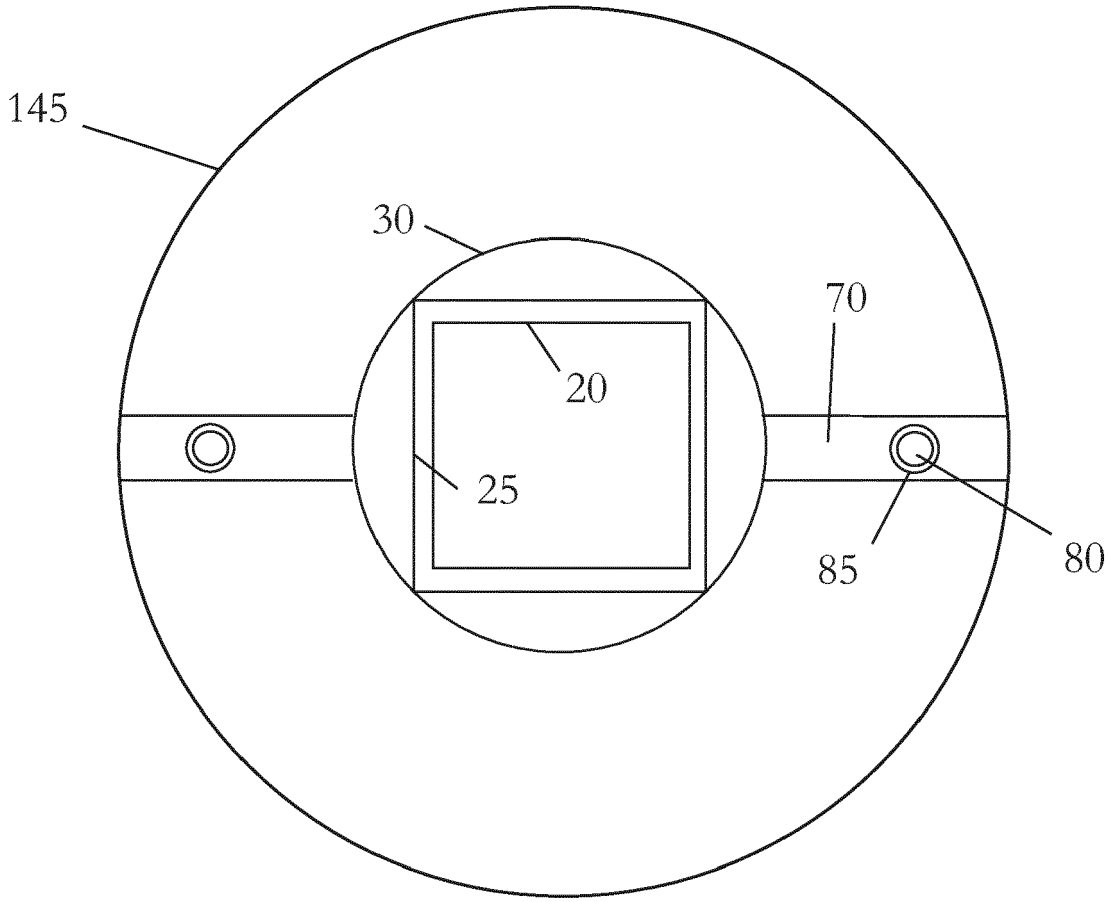


Figure 2



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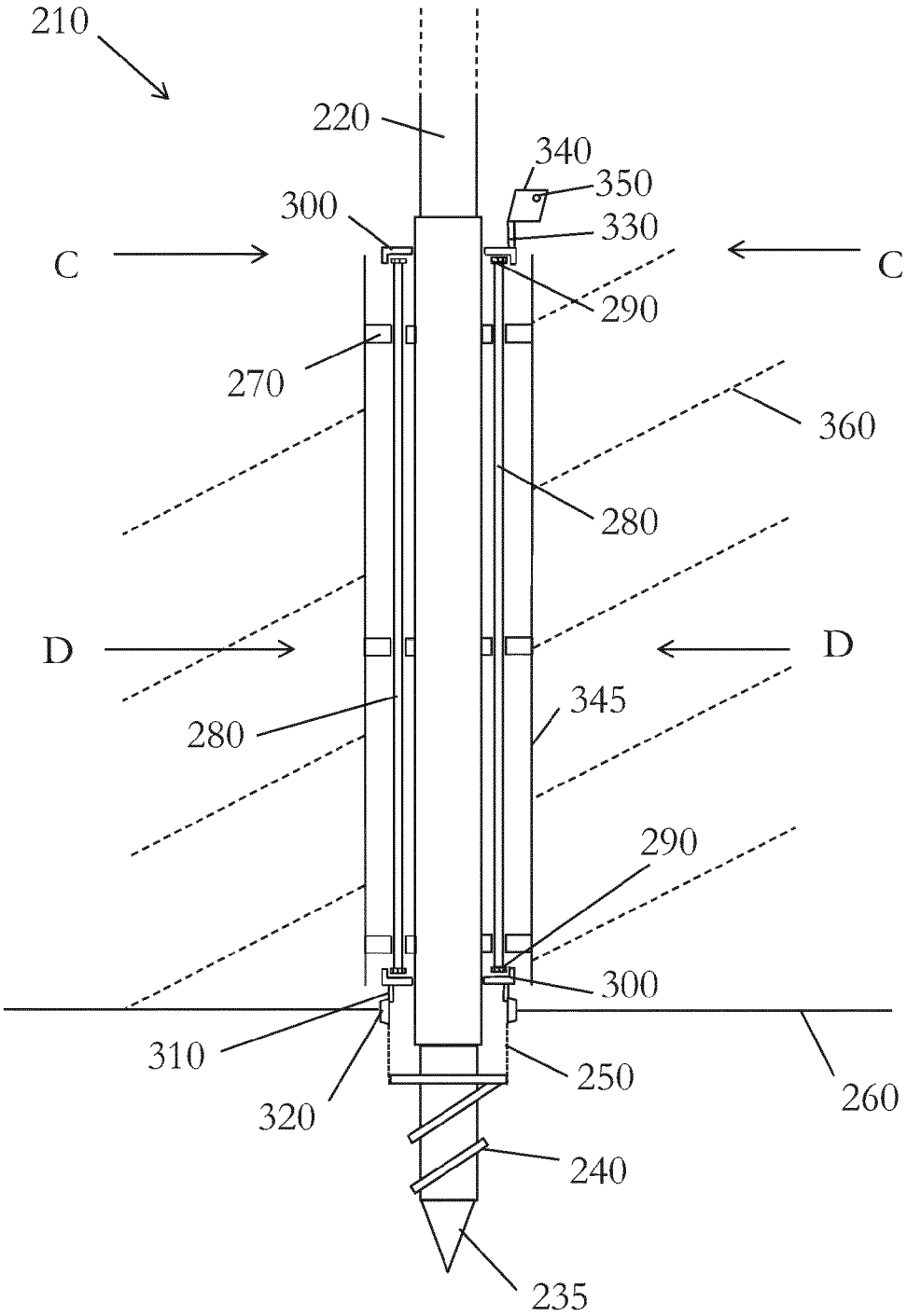
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Figure 4

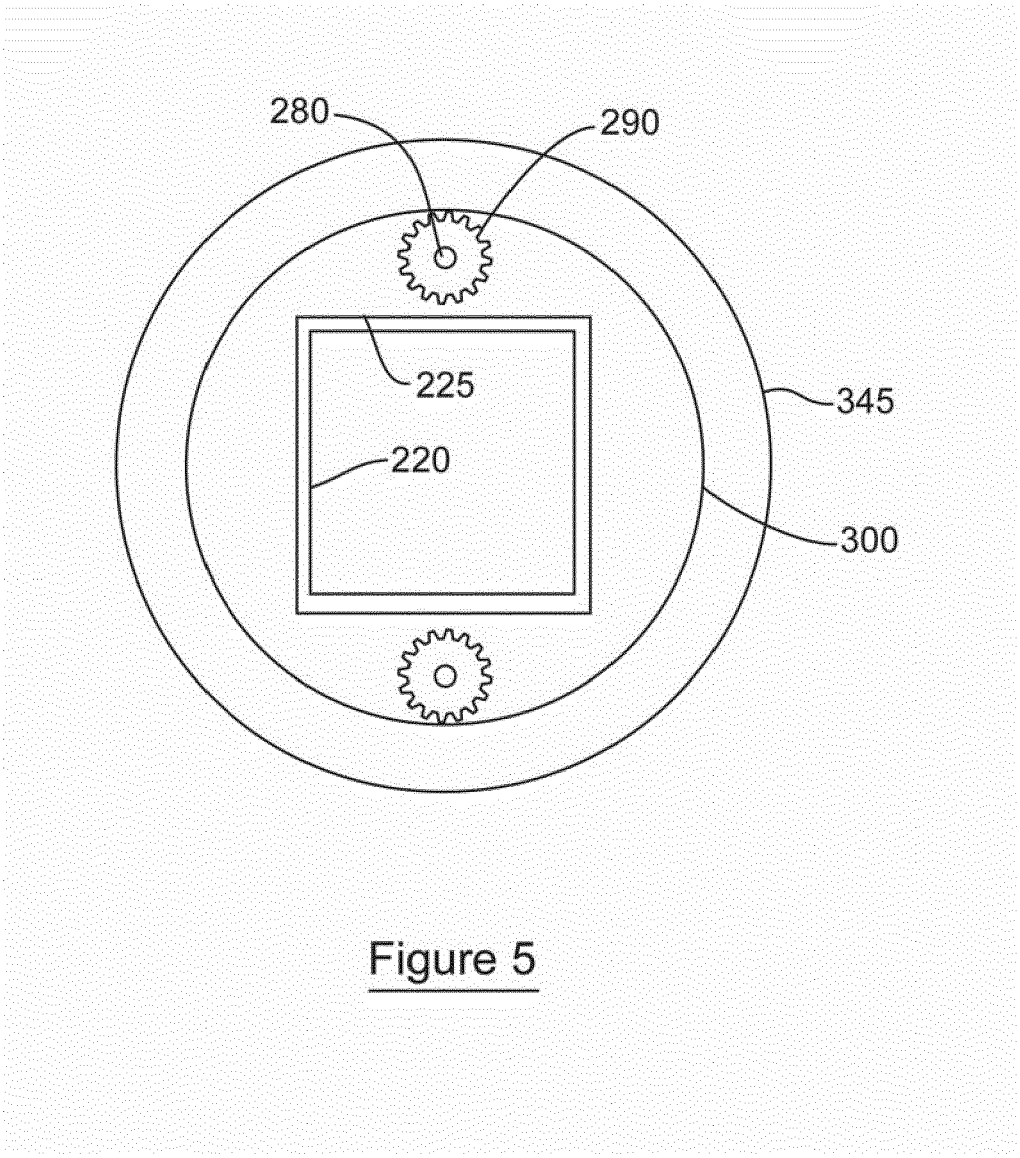

Figure 5

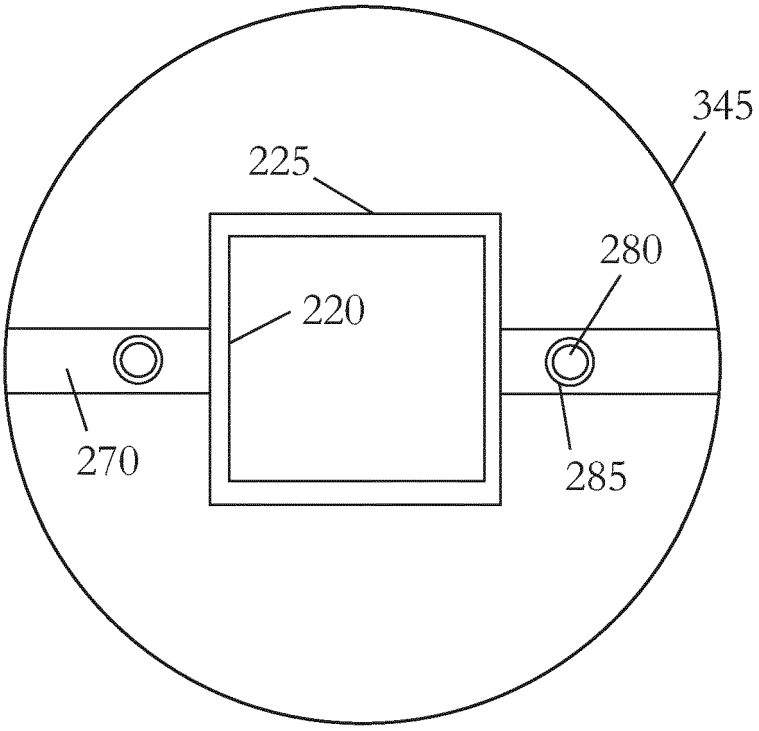

Figure 6

REFERENCES CITED IN THE DESCRIPTION

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