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(54) Title: ENCASED SOIL AUGER APPARATUS FOR ARCHEOLOGICAL ASSESSMENTS AND METHOD OF OPERATING THE SAME

(57) Abstract: An encased soil auger apparatus is provided. The encased soil auger apparatus comprises an auger casing forming a hollow cylindrical body. A wall of the auger casing has a plurality of openings having a predetermined size for enabling passage of particles therethrough. A soil auger having a helical screw blade is disposed in the auger casing in a coaxial fashion. A soil engaging end portion of the auger protrudes a first end of the auger casing.

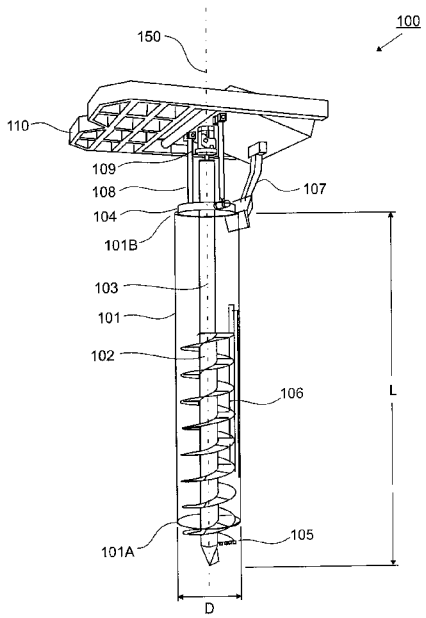


Figure 1a

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ENCASED SOIL AUGER APPARATUS FOR ARCHEOLOGICAL ASSESSMENTS AND METHOD OF OPERATING THE SAME

FIELD OF THE INVENTION

The present invention relates to systematic archaeological test pitting, and more particularly, to an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments and a method of operating the same.

BACKGROUND OF THE INVENTION

Present-day archaeological testing of areas of archaeological potential is conducted by manually excavating numerous test pits – typically, several hundred test pits are excavated for larger scale projects - arranged in a geo-referenced grid covering the area. The standard size of the test pits used by archaeologists to test the ground for archaeological remains is 50 cm by 50 cm cross-section and depth of 120 cm. The soil extracted from the test pits is then, typically manually, screened for archaeological remains before the test pits are back filled.

Manual testing for archaeological remains is extremely labour intensive, costly, and time consuming, typically at a rate of approximately 10 test pits per person per standard 8 hour work day.

Furthermore, manually dug test pits are not of the same size, substantially reducing the accuracy of the testing due to the non-uniformity of the test pits. Another problem of manual testing is "spill-in" of sediments surrounding the test pits – in particular, gravel rich soil - causing cross-contamination of the extracted soil, further reducing the accuracy of the testing.

Manually dug test pits are excavated to a maximum depth of 120 cm to minimize risk of operator injury, thus the testing of particularly older sites is substantially limited, i.e. the manual digging is stopped prior reaching the depths where archaeological remains may be found.

Employment of conventional augers in archaeological testing is limited to very small soil augers. Holes having a diameter substantially smaller than 50 cm are drilled in close proximity to each other and the soil retrieved by the auger is then processed by hand on the surface. Again, the "spill-in" effect is encountered by which soil from the auger and/or profile of the fresh test pit during excavation cross-contaminates the extracted soil.

While employment of tubular soil augers, as disclosed, for example, in US Patents 4,653,336 and 8,365,638, increases the sample retaining capacity of the auger, the size of the auger is still substantially limited, as well as the "spill-in" effect is still encountered.

It is desirable to provide an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that substantially prevents "spill-in" effects.

It is also desirable to provide an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables soil extraction and soil screening using the same apparatus.

It is also desirable to provide an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables provision of water during the soil screening.

It is also desirable to provide a method of operating an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables soil extraction and soil screening using the same apparatus.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that substantially prevents "spill-in" effects.

Another object of the present invention is to provide an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables soil extraction and soil screening using the same apparatus.

Another object of the present invention is to provide an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables provision of water during the soil screening.

Another object of the present invention is to provide a method of operating an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables soil extraction and soil screening using the same apparatus.

According to one aspect of the present invention, there is provided an encased soil auger apparatus. The encased soil auger apparatus comprises an auger casing forming a hollow cylindrical body. A wall of the auger casing has a plurality of openings having a predetermined size for enabling passage of particles therethrough. A soil auger having a helical screw blade is disposed in the auger casing in a coaxial fashion. A soil engaging end portion of the auger protrudes a first end of the auger casing.

According to the aspect of the present invention, there is provided an encased soil auger apparatus. The encased soil auger apparatus comprises an auger casing forming a hollow cylindrical body. A wall of the auger casing has a plurality of openings having a predetermined size for enabling passage of particles therethrough. A soil auger having a helical screw blade is disposed in the auger casing in a coaxial fashion. A soil engaging end portion of the auger protrudes a first end of the auger casing. The soil engaging end portion of the auger extends from a longitudinal axis approximately a same distance as an outside radius of the auger casing. The encased soil auger apparatus further comprises an end cap for enclosing the soil engaging end portion of the auger after extraction of the soil.

According to the aspect of the present invention, there is provided a method of extracting and screening soil. An encased soil auger apparatus according to the invention is provided. The

encased soil auger apparatus is placed at a predetermined location with a longitudinal axis thereof oriented substantially vertical. The encased soil auger apparatus is drilled into the soil until a predetermined depth is reached. The retracting the encased soil auger apparatus containing the extracted soil is then retracted and an end cap is mounted to the auger casing for enclosing the soil engaging end portion of the auger. The encased soil auger apparatus is then moved such that the longitudinal axis thereof is oriented substantially horizontal and the extracted soil contained in the auger casing is screened.

The advantage of the present invention is that it provides an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that substantially prevents "spill-in" effects.

A further advantage of the present invention is that it provides an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables soil extraction and soil screening using the same apparatus.

A further advantage of the present invention is that it provides an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables provision of water during the soil screening.

A further advantage of the present invention is that it provides a method of operating an encased soil auger apparatus for mechanical extraction and processing of soil for archeological assessments that enables soil extraction and soil screening using the same apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention is described below with reference to the accompanying drawings, in which:

Figures 1a and 1b are simplified block diagrams illustrating in side perspective views an encased soil auger apparatus according to a preferred embodiment of the invention;

Figures 1c to 1e are simplified block diagrams illustrating in side perspective views the encased soil auger apparatus according to a preferred embodiment of the invention installed on a skid steer in a raised position for drilling, fully deployed in the drilled hole, and in a horizontal position for screening soil, respectively;

Figures 2a to 2c are simplified block diagrams illustrating in bottom perspective views a mounting mechanism for the encased soil auger apparatus according to a preferred embodiment of the invention;

Figures 2d to 2f are simplified block diagrams illustrating in a front view, a side view, and a bottom view, respectively, the mounting mechanism for the encased soil auger apparatus according to a preferred embodiment of the invention;

Figures 3a and 3b are simplified block diagrams illustrating in side perspective views the encased soil auger apparatus according to a preferred embodiment of the invention with the auger screen and end cap separated and attached, respectively;

Figures 4a and 4b are simplified block diagrams illustrating in a side perspective view and a side view a soil engaging end portion of the auger screw blade of the encased soil auger apparatus according to a preferred embodiment of the invention; and,

Figures 5a to 5h are simplified block diagrams illustrating in side perspective views the encased soil auger apparatus according to a preferred embodiment of the invention installed on a skid steer in different modes of operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention belongs. Although any methods and materials similar or equivalent to those described herein can be used

in the practice or testing of the present invention, the preferred methods and materials are now described.

While the description of the preferred embodiments hereinbelow is with reference to a quick mount plate for connecting the encased soil auger apparatus to the boom of a skid-steer, it will become evident to those skilled in the art that the embodiments of the invention are not limited thereto, but are adaptable for connecting the same to other light-heavy duty mechanical implements such as, for example, an excavator or tractor.

Referring to Figures 1a to 1e, an encased soil auger apparatus 100 according to a preferred embodiment of the invention is provided. The encased soil auger apparatus 100 comprises an auger casing 101 forming a hollow cylindrical body. A wall of the auger casing 101 has a plurality of openings 106 disposed therein having a predetermined size for enabling passage of particles therethrough. A soil auger 102 having a helical screw blade is disposed in the auger casing 101 in a coaxial fashion – longitudinal axis 150. A soil engaging end portion 105 of the auger 102 protrudes a first end 101A of the auger casing 101. A second end 101B of the auger casing 101 is pivotally movable mounted to an auger quick mount plate 110 via split end plate and mounting ring 104, pivoting control arms 108, and auger support bracket 107, as will be described in more detail hereinbelow with reference to Figures 2a to 2f. The auger support bracket 107 articulates the encased soil auger apparatus 100 enabling proper vertical orientation of the same for drilling. Auger drive shaft 103 is connected to auger drive assembly 109 and pivotally movable in a conventional fashion.

In an example implementation the encased soil auger apparatus 100 has a length L of 120 cm and a diameter D of 60 cm, enabling drilling of a standard test pit, and is driven using a hydraulic drive providing 113.5 litres per minute hydraulic pressure. Of course the encased soil auger apparatus 100 can be adapted to various different sizes, for example, having a length L greater than 120 cm, enabling testing of older sites where archaeological remains may be found at greater depths.

Optionally, as illustrated in Figure 1b, a water inlet – preferably comprising an injector such as,

for example, a spray nozzle - is disposed in end plate 116 and connected to articulating pipe 115 and flexible hose 114 via articulating pipe 115 through auger quick mount plate 110. The flexible hose 114 is, for example, connected to a water pump and water tank coupled to skid-steer 10 for pumping water for injection into the auger casing 101 during screening, as will be described hereinbelow.

Figures 1c to 1e illustrate the encased soil auger apparatus 100 connected to boom 12 of the skid-steer 10 with: Figure 1c illustrating the encased soil auger apparatus 100 in a raised vertical position prior drilling; Figure 1d illustrating the encased soil auger apparatus 100 fully disposed in drilled test pit 14; and Figure 1e illustrating the encased soil auger apparatus 100 a raised horizontal position for soil screening.

Referring to Figures 2a to 2f, the pivoting control arms 108 are, at a first end thereof, pivotally movable mounted to a commercially available auger quick mount plate 110 via, for example, steel mounting plates 122 welded to the auger quick mount plate 110 and gusseted mounting tabs 123 welded or otherwise fastened in a conventional manner to the respective steel mounting plate 122. A second end of each of the pivoting control arms 108 is pivotally movable mounted to the split end plate and mounting ring 104 in a conventional manner.

Figure 3a illustrates the soil auger 102 mounted to the quick mount plate 110 with separated auger casing 101 and separated end cap 119. The auger casing 101 is made, for example, as a frame structure comprising two rings 101A forming the two end portions of the auger casing 101 and connecting members 101B with the rings 101A and connecting members 101B made of, for example, sheet material and welded together in a conventional manner. Screen 101C, for example, a steel wire mesh, is mounted to the frame structure in a conventional manner. Alternatively, the auger casing 101 is made of sheet material forming the wall thereof, for example, steel sheet material is rolled in cylindrical shape and welded in a conventional manner. Openings 106 are disposed in the sheet material in conventional manner using punching or laser cutting technology. The auger casing 101 has, preferably, a wall thickness between 1/8'' and ¾'' depending on the type of sediment in the test area. The mesh size or the size of the openings is determined in dependence upon the size of particles that are desired to be retained in the auger

screen 101 after screening. Preferably, the size is a standard size used in archaeological testing, for example 1/4''. Optionally, auger casings 101 having different screen sizes, for example, 1/8'', are provided, in order to enable changing of the screen size during testing, for example, depending if archaeological remains have been found or not. The second end of the auger casing 101 is mounted to the mounting ring 104 in a conventional manner using, for example, screw fasteners or a clamping mechanism, enabling simple mounting/removal of the same.

End cap 119 is made in a similar fashion as the auger casing 101 as a frame structure with a wire mesh or made of sheet material having openings disposed therein. Optionally, the openings re omitted in the end cap 119. The end cap 119 further comprises a fastening mechanism such as, for example, chain binders or ratchet straps 120 to easily and removably attach the same to the auger casing 101. The end cap 119 is employed for enclosing the soil engaging end portion of the auger after extraction of the soil and during screening.

Figure 3b illustrates the soil auger 102 having the auger casing 101 and the end cap 119 mounted thereto, as it is used after extraction of the soil and during screening.

As illustrated in Figures 4a and 4b, the soil engaging end portion 105 of the auger 102 extends from the longitudinal axis 150 approximately a same distance as an outside radius R of the auger casing 101, in order to provide clearance for the auger casing in the borehole. Preferably, the soil engaging end portion 105 comprises a plurality of cutting teeth 105A with an outer cutting tooth 105A.1 extending from an outside edge 102A of the auger screw blade 102.

Referring to Figures 5a to 5h, a method of extracting and processing soil according to a preferred embodiment of the invention is provided. In an example implementation the encased soil auger apparatus 100 is mounted to the boom 12 of the skid-steer 10. The encased soil auger apparatus 100 is placed at a predetermined location with the longitudinal axis thereof oriented substantially vertical, as illustrated in Figure 5a. When in place, the encased soil auger apparatus 100 is drilled into the soil until a predetermined depth, for example, 120 cm, is reached, as illustrated in Figure 5b. The encased soil auger apparatus 100 containing the extracted soil is then retracted and, after the complete removal of the encased soil auger apparatus 100 from the borehole, end cap 119 is

mounted to the auger casing 101 to enclose the soil engaging end portion of the soil auger 102, as illustrated in Figures 5c and 5d, respectively. Preferably, the end cap 119 is mounted to the auger casing 101 immediately after complete removal of the encased soil auger apparatus 100 from the borehole in order to prevent spillage of the extracted soil. The encased soil auger apparatus 100 is then moved such that the longitudinal axis thereof is oriented substantially horizontal, as illustrated in Figure 5e. The extracted soil contained in the auger casing 101 is then screened, for example, by rotating the soil auger 102 clockwise and counterclockwise in an alternating fashion. Smaller particles of the screened soil fall to the ground or are collected in a respective receptacle, as illustrated in Figures 5f and 5g, respectively. After screening, larger objects are collected in the end cap 119, for example, by moving the encased soil auger apparatus such that the longitudinal axis thereof is oriented substantially vertical and rotating the soil auger to transport the remaining larger objects into the end cap 119. The end cap 119 with the collected larger objects is then removed from the auger casing 101 and the encased soil auger apparatus 100 is ready for drilling the next test pit, as illustrated in Figure 5h. The collected larger objects are then investigated by an archaeologist to determine if the test pit is positive or negative for archaeological remains. Optionally, water is injected into the auger casing 101 during screening, Figures 5f and 5g.

The present invention has been described herein with regard to preferred embodiments. However, it will be obvious to persons skilled in the art that a number of variations and modifications can be made without departing from the scope of the invention as described herein.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. An encased soil auger apparatus comprising:
an auger casing forming a hollow cylindrical body, a wall of the auger casing having a plurality of openings having a predetermined size for enabling passage of particles therethrough; and,
a soil auger having a helical screw blade disposed in the auger casing in a coaxial fashion, a soil engaging end portion of the auger protruding a first end of the auger casing.

2. The encased soil auger apparatus according to claim 1 wherein the soil engaging end portion of the auger extends from a longitudinal axis approximately a same distance as an outside radius of the auger casing.

3. The encased soil auger apparatus according to claim 2 wherein the soil engaging end portion of the auger comprises a plurality of cutting teeth with an outer cutting tooth extending from an outside edge of the auger screw blade.

4. The encased soil auger apparatus according to claim 1 comprising an end plate mounted to a second end of the auger casing.

5. The encased soil auger apparatus according to claim 1 comprising an end cap for enclosing the soil engaging end portion of the auger after extraction of the soil.

6. The encased soil auger apparatus according to claim 5 wherein a wall of the end cap has a plurality of openings having a predetermined size for enabling passage of particles therethrough.

7. The encased soil auger apparatus according to claim 1 comprising a water inlet for injecting water into the auger casing through a second end thereof.

8. A method of extracting and screening soil comprising:
providing an encased soil auger apparatus according to claim1;

placing the encased soil auger apparatus at a predetermined location with a longitudinal axis thereof oriented substantially vertical;
drilling the encased soil auger apparatus into the soil until a predetermined depth is reached;
retracting the encased soil auger apparatus containing the extracted soil;
using an end cap enclosing the soil engaging end portion of the auger;
moving the encased soil auger apparatus such that the longitudinal axis thereof is oriented substantially horizontal; and,
screening the extracted soil.

9. The method according to claim 8 wherein during screening the soil auger is rotated clockwise and counterclockwise in an alternating fashion.

10. The method according to claim 8 comprising collecting larger objects in the end cap by moving the encased soil auger apparatus such that the longitudinal axis thereof is oriented substantially vertical.

11. The method according to claim 8 comprising injecting water into the auger casing during screening.

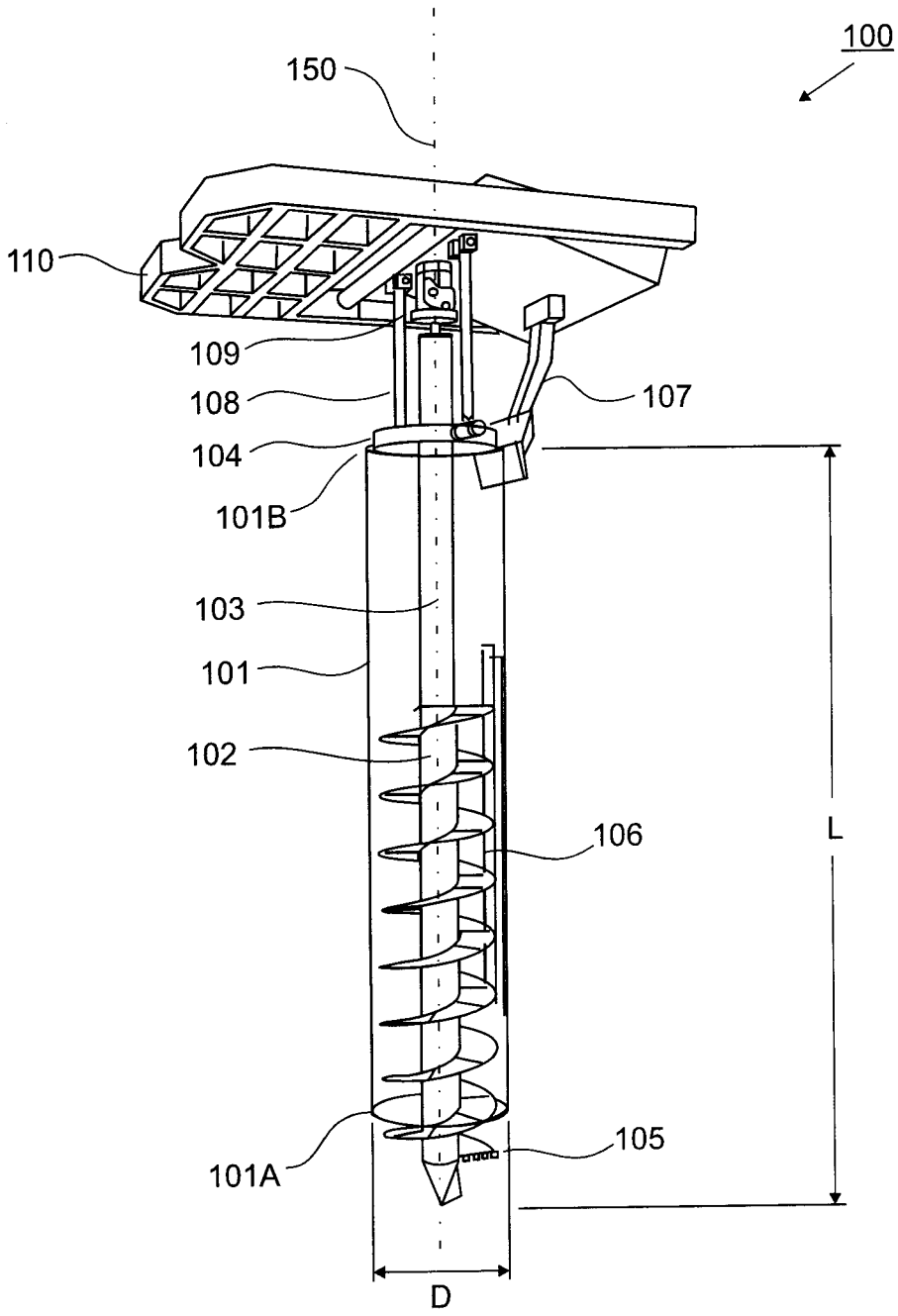


Figure 1a

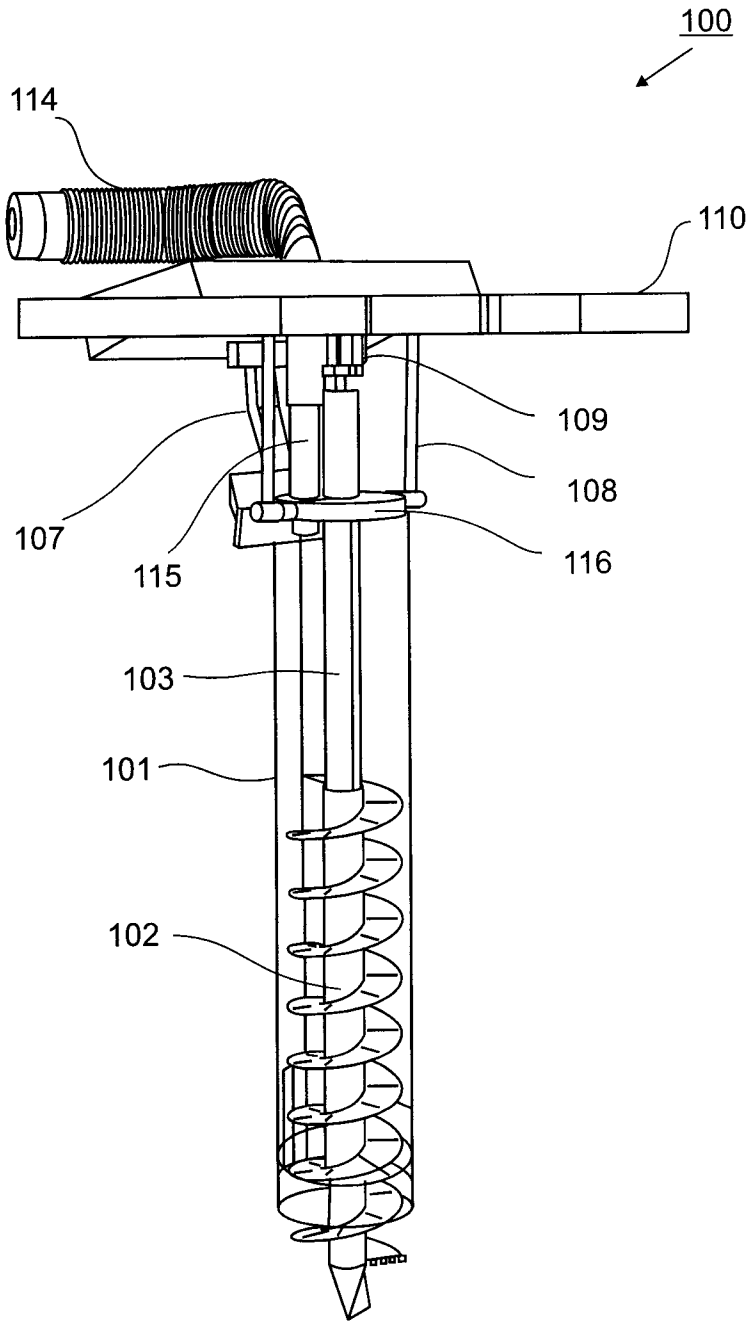


Figure 1b

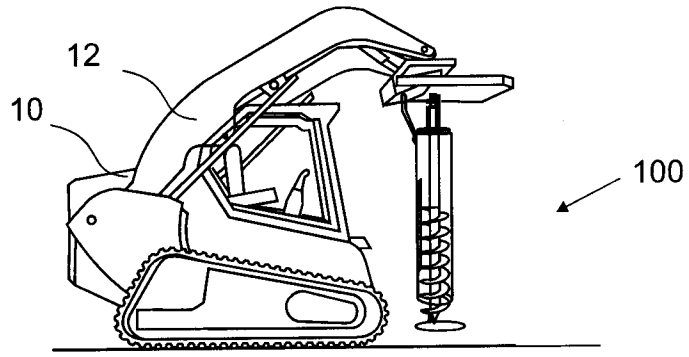


Figure 1c

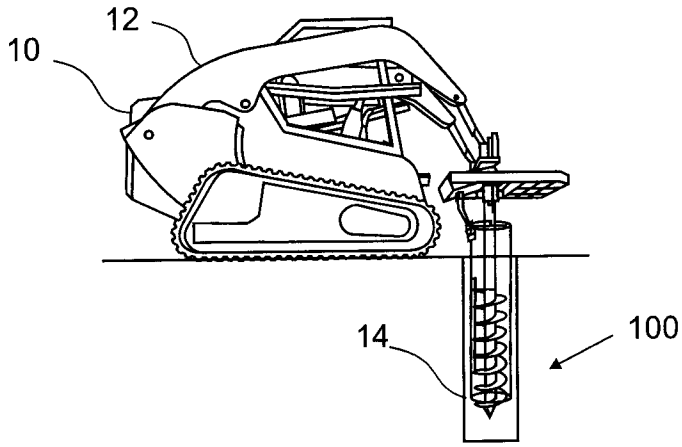


Figure 1d

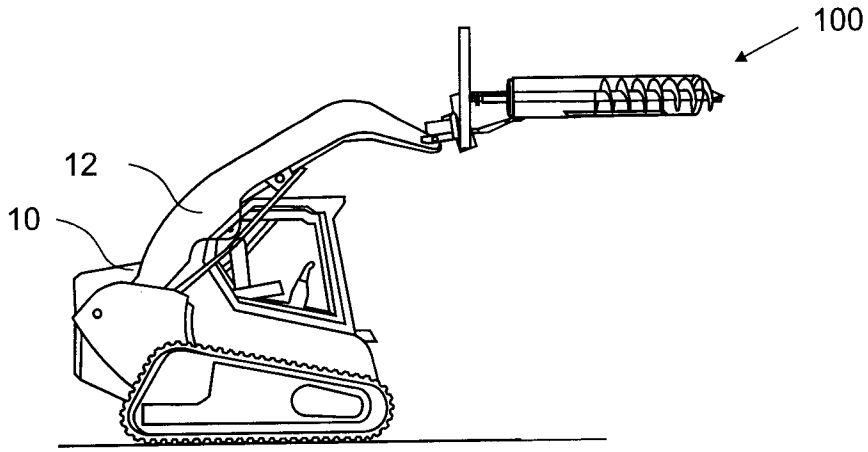


Figure 1e

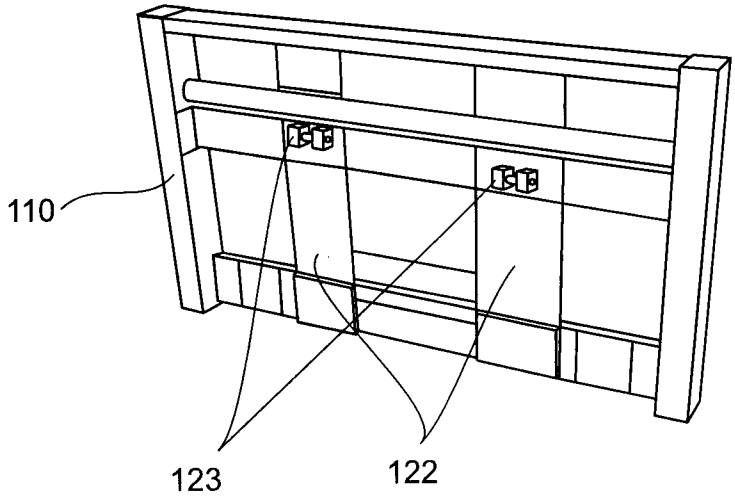


Figure 2a

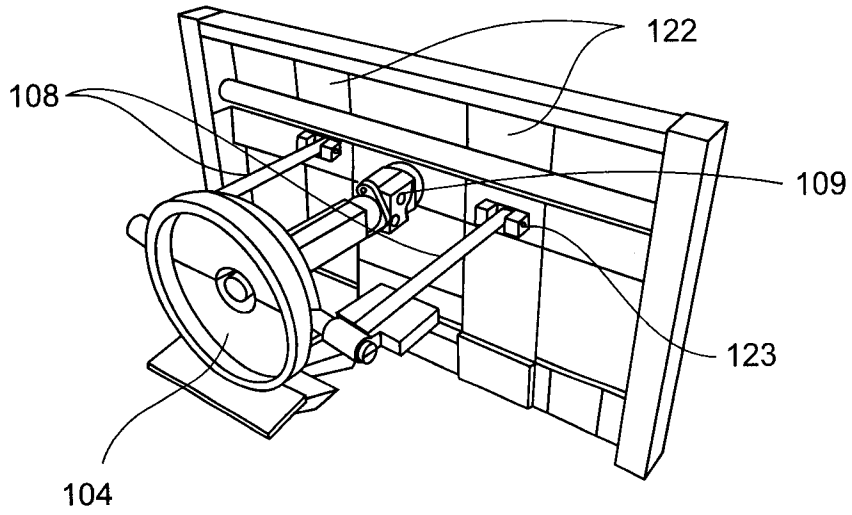


Figure 2b

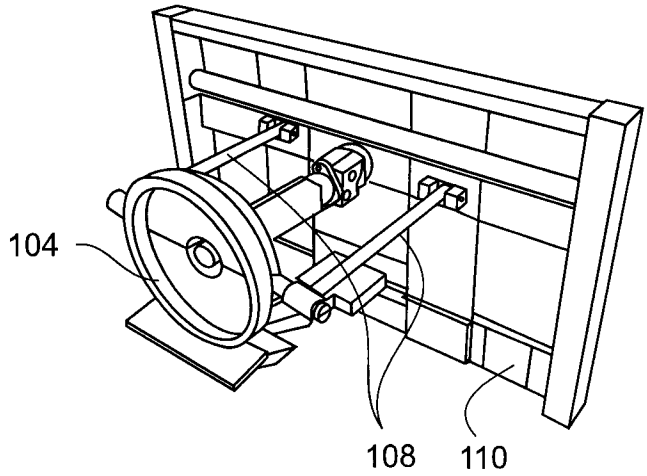


Figure 2c

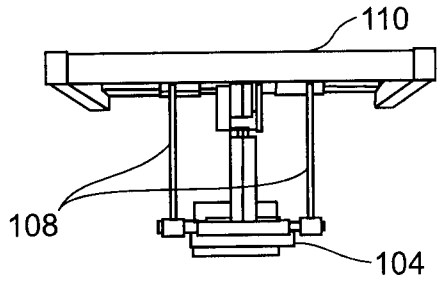


Figure 2d

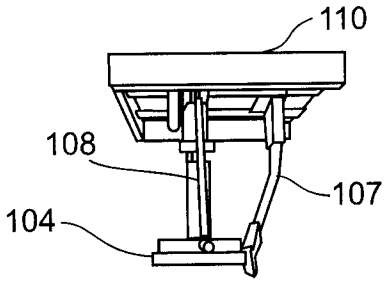


Figure 2e

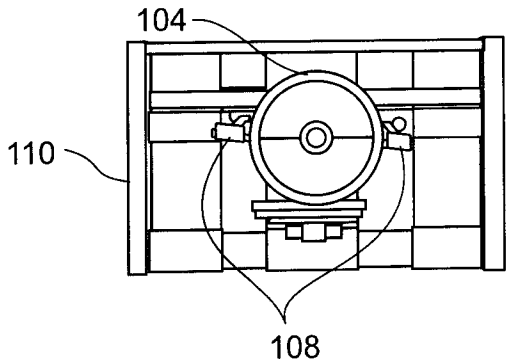


Figure 2f

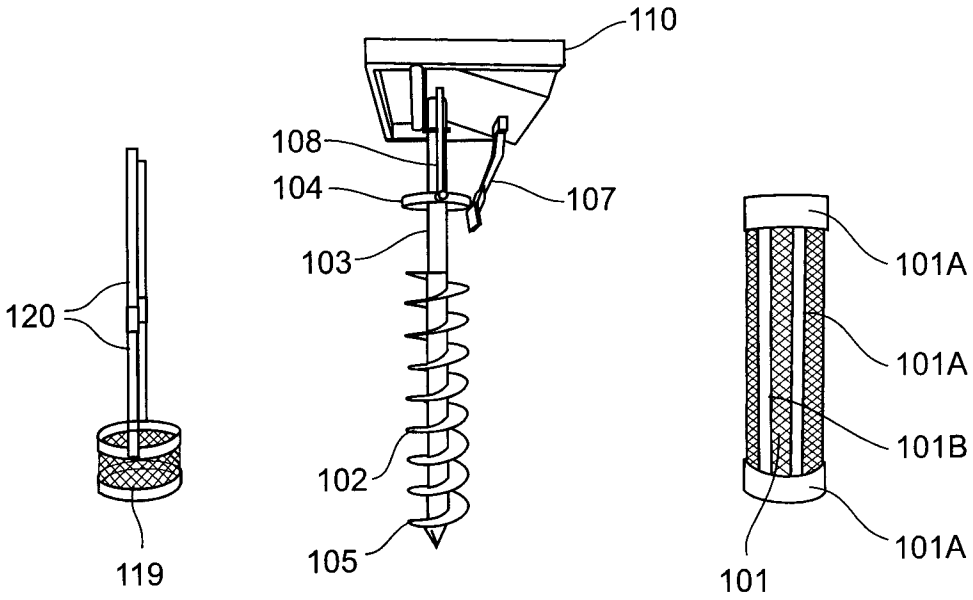


Figure 3a

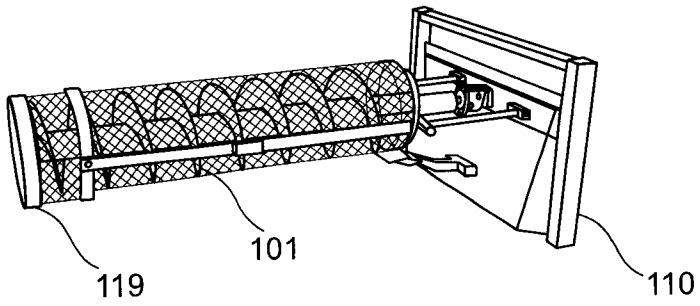


Figure 3b

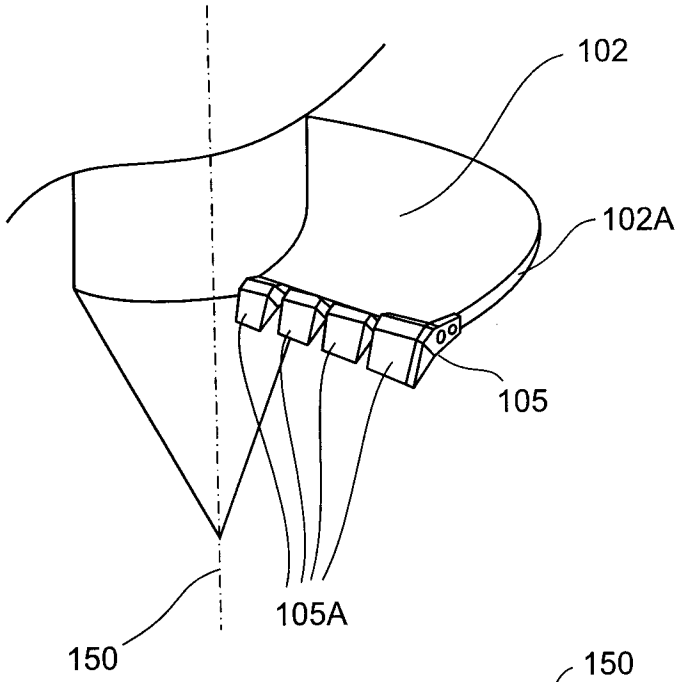


Figure 4a

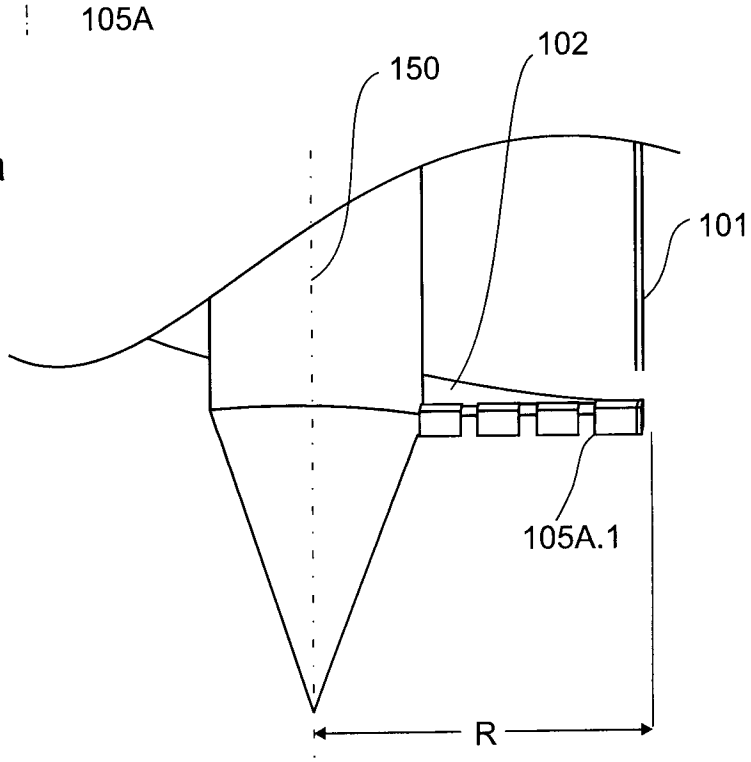


Figure 4b

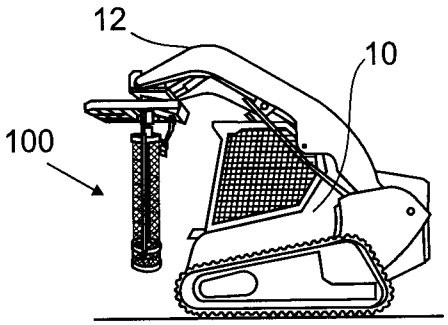


Figure 5a

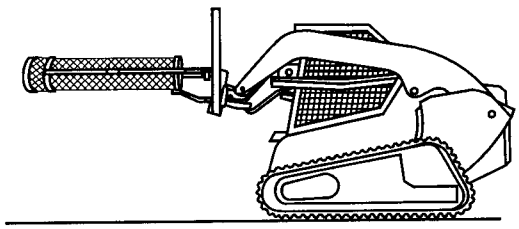


Figure 5e

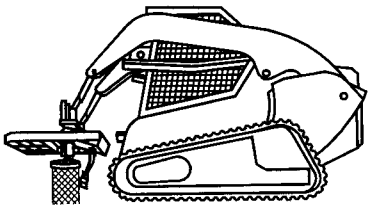


Figure 5b

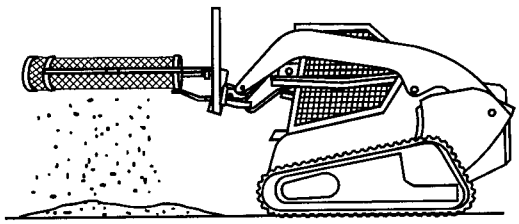


Figure 5f

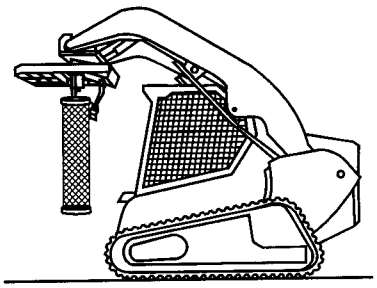


Figure 5c

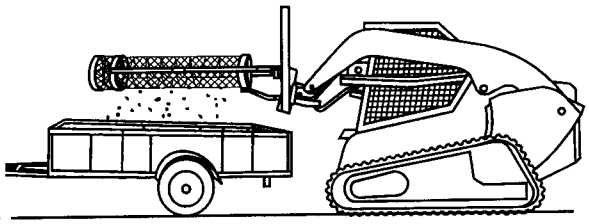


Figure 5g

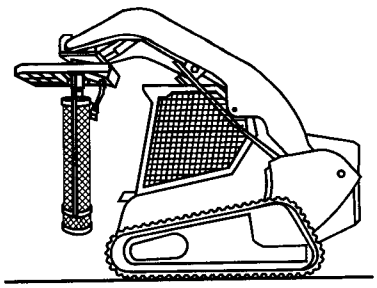


Figure 5d

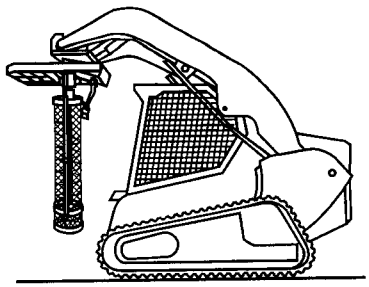


Figure 5h

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2017/000024

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***E21B 10/44*** (2006.01) , ***E02D 1/04*** (2006.01) , ***E21B 49/02*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: ***E21B 10/44*** (2006.01) , ***E02D 1/04*** (2006.01) , ***E21B 49/02*** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Databases: Questel Orbit, Canadian Patents Database

Search terms: auger, cylinder, casing, helical, screen, archeological, particles

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US7546887B2 (Schwab, G.) 16 June 2009 (16-06-2009) *Figures 1-6*	1-11
A	US4653336A (Vollweiler, A.) 31 March 1987 (31-03-1987) *Figures 1-6*	1-11
A	US8365638B2 (Paxton, F.) 05 February 2013 (05-02-2013) *Figure 2*	1-11
A	US5245878A (Underwood, J.) 21 September 1993 (21-09-1993) *Figures 3, 6-8*	1-11

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier application or patent but published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 25 July 2017 (25-07-2017)	Date of mailing of the international search report 25 July 2017 (25-07-2017)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Jim Triantafillou (819) 934-4268

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2017/000024

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