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(54) **Cutting head with a retractable threading tooth actuated by a rack/gear system**

Schneidkopf mit einfahrbarem, durch ein Zahnstangensystem betätigtem Gewindeschneidzahn

Tête de coupe avec dents de filetage rétractables actionnées par une crémaillère/système d'engrenage

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(73) Proprietor: **Soletanche Freyssinet
92500 Rueil Malmaison (FR)**

(72) Inventors:
• **Stansfield, Lewis**
92500 Rueil Malmaison (FR)
• **Ako, Steve**
92500 Rueil Malmaison (FR)

(74) Representative: **Balesta, Pierre et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

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EP 2 685 006 B1

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Description

Background of the invention

[0001] The present invention relates to a cutting head with a movable threading tooth for making a threaded continuous flight auger pile.

[0002] For making a bored pile or a cast-in place pile, it is usual to make use of a tool such as an auger that serves to dig a substantially cylindrical excavation corresponding to the dimensions of the pile that is to be made, and that is also for raising the excavated soil out of the bore.

[0003] When making concrete piles in a soil, it is advantageous to limit the diameter of the pile shaft to be bored. Indeed, when the diameter of the pile shaft is reduced, the cost of the pile is lowered.

[0004] However, the bearing capacity of the concrete pile greatly depends on the diameter of the pile. A technique to increase the bearing capacity of a pile, the shaft of which has a given diameter, is to make a thread or a helical groove in the internal wall of the pile bore. When the pile bore is filled with concrete to obtain the pile, the thread or helical groove is also filled with concrete so as to obtain a threaded continuous flight auger pile.

[0005] The present invention more precisely relates to a cutting head for making a threaded continuous flight auger pile, said cutting head comprising:

- a hollow cylindrical core having a longitudinal axis and a bottom end;
- a helical flight being mounted on an outside face of the hollow cylindrical core;
- a threading tooth presenting an extended position in which the threading tooth projects outside a volume defined by the periphery of the flight and a retracted position in which the threading tooth is disposed inside said volume;
- displacement means for displacing said threading tooth between said retracted position and said extended position, said displacement means comprising:
 - an inner hollow tubular member mounted to move into said hollow cylindrical core in translation along said longitudinal axis and disposed at least at the bottom end of said hollow cylindrical core;
 - control means for causing said threading tooth to be displaced between said retracted position and said extended position in response to the translation of the inner hollow tubular member relative to at least the bottom end of said hollow cylindrical core;

[0006] GB 2 440 939 describes such a drilling tool for making threaded continuous flight auger piles.

[0007] In this prior art document, the control means

comprises a wedge attached to the inner hollow tubular member, and a piston having an inclined surface connected to the rear part of the threading tooth. When the hollow tubular member is moved upwardly, the wedge acts against the inclined surface of the piston, which causes the displacement of the threading tooth toward its extended position.

[0008] For causing the displacement of the threading tooth towards its retracted position, the return system comprises a tension spring and a lever mounted in a protected volume.

Summary of the invention

[0009] An object of the invention is to provide a cutting head for making threaded continuous flight auger piles in which the control means for displacing the threading tooth is more robust than the one disclosed in GB 2 440 939.

[0010] According to the invention, the control means comprises:

- a rack fixed to the inner hollow tubular member,
- at least a gear cooperating with the rack, said gear being mounted on the bottom end of the hollow cylindrical core,
- a lever connected to the gear;
- a connecting rod pivotally connected to the lever and to the threading tooth, whereby the translation of the rack causes the displacement of the threading tooth.

[0011] When the inner hollow tubular member is moved downwardly in respect of the hollow cylindrical core, the downward movement of the hollow tubular member causes the downward translation of the rack in respect of the gear. As a result, the gear rotates in a direction where the lever pulls the connecting rod so as to displace the threading tooth to its retracted position.

[0012] During boring, a vertical downward force is applied on the inner hollow tubular member so that the rack is maintained in a low position in respect of the bottom end of the hollow cylindrical core. As a result, the rotation of the gear is advantageously blocked by the rack, so that the threading tooth is firmly maintained in the retracted position.

[0013] Such configuration for maintaining the threading tooth in its retracted position is more robust than the device disclosed in prior art.

[0014] When the cutting head begins to be raised, the inner hollow tubular member moves upward in respect of the hollow cylindrical core. This causes the upward displacement of the rack in respect of the bottom end of the hollow cylindrical core. This displacement of the rack causes the rotation of the gear in a direction where the lever pushes the connecting rod, whereby the threading tooth is displaced to its extended position.

[0015] During the raising of the cutting head, a vertical upward force is applied to the inner tubular member so

that the rack is maintained in a top position in respect of the bottom end of the hollow cylindrical core. As a result, the rotation of the gear is advantageously blocked by the rack, so that the threading tooth is firmly maintained in the extended position.

[0016] Advantageously, the threading tooth is mounted to move in translation perpendicularly to the longitudinal axis.

[0017] Advantageously, the cutting head further comprises a protection box fixed to the bottom end of the hollow cylindrical core for receiving the gear, said protection box surrounding a window formed in the bottom end of the hollow cylindrical core, and wherein the rack projects into the protection box through said window.

[0018] Preferentially, the lever and the connecting rod are disposed outside of the protection box to enable the protection box to be sealed against ingress of water or soil during boring, or concrete when the pile is being formed.

[0019] Advantageously, the cutting head comprises means for limiting the relative vertical displacement between the inner tubular member and the hollow cylindrical core.

[0020] For this purpose, the rack presents a top, the window presents a top, and wherein the top of the rack is configured to come into abutment with the top of the window so as to limit the relative displacement between the inner hollow tubular member and the hollow cylindrical core.

[0021] Alternatively, the inner hollow tubular member comprises a shoulder configured to come into vertical abutment with a top portion of the hollow cylindrical core so as to limit the relative displacement between the inner hollow tubular member and the hollow cylindrical core.

[0022] Advantageously, the bottom end of the hollow cylindrical core comprises a hinged cap for closing the hollow cylindrical core during boring.

[0023] Preferentially, the threading tooth extends orthoradially in respect to the longitudinal axis. The orthoradial direction is a direction perpendicular to the radius and to the vertical direction.

[0024] According to a preferred embodiment, the cutting head comprises an upper part and a lower part, wherein the lower part comprises the hollow cylindrical core and said control means, wherein the upper part has a lower end, wherein the inner hollow tubular member is fixed to the lower end and extends along the length of the hollow cylindrical core, and wherein the upper part is movable in translation relative to the lower part over a predetermined length.

[0025] Preferentially, the cutting head further comprises means for constraining in rotation said upper and lower part relative to each other.

[0026] Advantageously, the cutting head further comprises a monitoring device for monitoring the position of the threading tooth. An interest of such monitoring device is to control the making of the helical groove in the soil.

[0027] Preferentially, the monitoring device comprises

a movement sensor disposed in the protection box for monitoring the movement of the rack and a data logger connected to the movement sensor for recording the monitoring information provided by the movement sensor during the making of the pile.

[0028] The present invention also relates to a machine for making a threaded pile in a soil comprising a cutting head according to the invention and a supply system to deliver a liquid construction material, for instance concrete, through said hollow cylindrical core and said inner hollow tubular member.

[0029] With the invention, the information of the position of the threading tooth enable control of the structure of the pile.

[0030] The data logger is preferentially but not exclusively read and analyzed after the completion of the pile.

[0031] Advantageously, the machine further comprises means for downloading the information stored in the data logger after the making of the pile, and a display device for displaying said information.

[0032] The present invention further relates to a machine for making a threaded pile in a soil comprising a cutting head according to the invention, a monitoring device for monitoring in real time the position of the threading tooth during the making of the pile, a computer connected to the monitoring device, and a display device connected to the computer for displaying in real time the position of the threading tooth.

[0033] Such machine makes it possible to control in real time the making of the pile.

Brief description of the drawings

[0034]

- figure 1 shows a vertical section of a threaded continuous flight auger pile;
- figure 2 illustrates a machine comprising a cutting head according to the present invention;
- figure 3 is a side view of the cutting head when the threading tooth is in its retracted position;
- figure 4 is a detailed view of the upper end of the cutting head when the threading tooth is in its retracted position;
- figure 5 is a vertical section view of the upper end of the cutting head of figure 4;
- figure 6 is a horizontal section view of the means for constraining in rotation the top and bottom parts of the cutting head of figure 3;
- figure 7 is a vertical section view of the bottom end of the cutting head, showing the rack and the gear when the threading tooth is in its retracted position;
- figure 8 is an isometric view of the bottom end of the cutting head, showing the threading tooth in its retracted position;
- figure 9 is a horizontal section view of the bottom end of the cutting head of figure 8;
- figure 10 is a side view of the cutting head according

to the invention, the threading tooth being in its extended position;

- figure 11 is a detailed view of the upper end of the cutting head, the bottom part having translated vertically in respect of the upper;
- figure 12 is a vertical section view of figure 11;
- figure 13 is a vertical section view of the bottom end of the cutting head, showing the rack and the gear when the threading tooth is in its extended position;
- figure 14 is an isometric view of the bottom end of the cutting head, showing the threading tooth in its extended position; and
- figure 15 is a horizontal section view of the bottom end of the cutting head of figure 14.

Detailed description

[0035] Figure 1 illustrates a vertical section through a pile 10 made in a soil S, said pile having a helical thread 12. Such pile 10 is made with the machine 100 comprising the cutting head 20 according to the present invention.

[0036] As explained in detail below, the cutting head 20 is configured for making a pile bore in soil S with a helical groove cut into the soil on the inside of the bore. The pile bore is made during the downward movement of the cutting head. After completion of the bore, the cutting head 20 is raised and concrete is injected from the bottom end of the cutting head into the pile bore and into the groove, so as to make the threaded pile 10.

[0037] The cutting head 20 according to the invention is mounted on the boring machine 100 having a vertical mast 102 on which is mounted a rotary drive 104 supported by a sledge 106.

[0038] The sledge 106 can be raised or lowered while sliding vertically on the front face 102a of the mast 102.

[0039] As illustrated in figure 2, the cutting head 20 with extension auger 21 are attached to a Kelly bar 108, which passes through the rotary drive 104 and has a central tube through which concrete can be pumped to cutting head 20.

[0040] The rotary drive 104 imparts rotary motion to the Kelly bar 108, which rotates the cutting head 20 and extension auger 21. Raising or lowering the sledge 106 imparts vertical motion to the Kelly bar 108, extension auger 21 and cutting head 20.

[0041] On completion of boring, a liquid construction material, preferentially concrete, is delivered through said cutting head while the sledge 106 is raised. For that purpose, concrete is pumped through an injection pipe 110 and swivel 112 attached to the top of the Kelly bar 108.

[0042] Referring to figures 3 to 6, it is noted that cutting head 20 has an upper part 22 and a lower part 24 connected together by means for constraining in rotation said upper and lower part relative to each other. In this example, means for constraining the rotation comprises a hexagonal drive coupling 26 visible on figure 6 which has a female outer part 28 and a male inner part 30.

[0043] The upper part 22 has a female coupling 22a at its upper end to connect to a male coupling at the lower end of the extension auger 21, and a female coupling 22b at its lower end connected to a male coupling 22c attached to the upper end of the male part 30 of the hexagonal drive coupling 26.

[0044] A short length of helical auger flight 32 is fixed around the two female couplings 22a and 22b which form the stem of the upper part 22.

10 [0045] The lower part comprises a hollow cylindrical core 34 having a longitudinal axis X-X'. In this example, the hollow cylindrical core 34 comprises the female hexagonal drive coupling 28 and a stem tube 36, the upper end of which is fixed to the female hexagonal drive coupling 28.

15 [0046] An outlet tube 38 is disposed at the bottom end 34a of the hollow cylindrical core 34. The outlet tube 38 has a hinged cap 40 for closing the hollow cylindrical core during the boring.

20 [0047] The lower part 24 of the cutting head 20 has a continuous helical auger flight 42 fixed around the stem tube 36 and the female hexagonal drive coupling 28.

[0048] The auger flights 42 and 32 form preferentially a continuous helical path when the cutting head 20 is lowered into the soil S.

25 [0049] The cutting head 20 further comprises an inner hollow tubular member 43 formed by the male hexagonal drive coupling 30 and an extension tube 44, the upper end of which being attached to the male hexagonal drive coupling 30. The extension tube 44 has a lower end 44a extending into the outlet tube 38.

30 [0050] The inner hollow tubular member 43 is mounted to move into said hollow cylindrical core 34 in translation along said longitudinal axis X-X'. Furthermore, in this example, the inner hollow tubular member 43 extends along the entire length of the hollow cylindrical core 34 so as to be disposed at least at the bottom end of said hollow cylindrical core 34.

35 [0051] When the extension auger 21 is raised, the upper part 22 of the cutting head is raised, and the inner hollow tubular member 43 slides within the hollow cylindrical core 34 along a predetermined length.

[0052] As will be explained more in detail below, the cutting head 20 further comprises a threading tooth 50 presenting an extended position, shown on figures 10, 14 and 15, in which the threading tooth projects outside a volume defined by the periphery of the flight, and a retracted position shown on figures 3, 8 and 9 in which the threading tooth is disposed inside said volume.

40 [0053] The movable threading tooth 50 is disposed near the lower end of the cutting head 20, and is in its retracted position when boring into the ground, but is in its extended position so as to extend outwards beyond the external diameter of the cutting head when the extension auger is raised.

45 [0054] The cutting head 20 accordingly comprises displacement means 52 for displacing said threading tooth 50 between said retracted position and said extended

position.

[0055] The displacement means **52** comprises the inner hollow tubular member **43** as well as control means **54** for causing said threading tooth **50** to be displaced between said retracted position and said extended position in response to the translation of the inner hollow tubular member **43** relative to at least the bottom end **34a** of said hollow cylindrical core **34**.

[0056] According to the present invention, the control means comprises a rack **56** fixed to the inner hollow tubular member **43**. More precisely, in this example, the rack **56** is attached to the lower end of the extension tube **44** just above the bottom end **44a** of the extension tube **44**.

[0057] The control means further comprises a gear **58** cooperating with the rack **56**, said gear being mounted on the bottom end of the hollow cylindrical core.

[0058] The rotation axis **A** of the gear extends horizontally. The gear is disposed outside the hollow cylindrical core **43**, below the flight **42**.

[0059] Moreover, the control means **54** also comprises a lever **60** connected to the gear **58**. In this embodiment, the lever **60** is attached to the gear **58** so that it rotates with the gear **58** about axis **A**.

[0060] The lever **60** comprises an end **60a** which is pivotally connected to a first end **62a** of a connecting rod **62**. The second end **62b** of the connected rod, opposite to the first end, is pivotally connected to the threading tooth **50**.

[0061] From figures **7** and **8**, it is noted that the vertical translation of the inner hollow tubular member causes the vertical displacement of the rack **56**, which causes the rotation of the lever **60**. As a result, the lever is displaced, which causes the displacement of the threading tooth.

[0062] In this example, the connection point **B** between the lever **60** and the connecting rod **62** is below the rotation axis **A** of the gear **58**. The gear **58** and the threading tooth **50** are disposed on both sides of a plane that contains the longitudinal axis X-X' and that is parallel to the rotation axis **A** of the gear **50**.

[0063] Accordingly, when the inner hollow tube **43** is moved upward in respect of the hollow cylindrical core **34**, the displacement of the rack **56** causes the rotation of the gear **58** in a sense in which the connecting rod **62** pushes the threading tooth **50** toward its extended position.

[0064] As can be seen on figure **15**, the threading tooth **50** extends orthoradially in respect to the longitudinal axis X-X'.

[0065] Similarly, when the inner hollow tube **43** is moved downward in respect of the hollow cylindrical core **34**, the displacement of the rack **56** causes the rotation of the gear **58** in a sense in which the connecting rod **62** pulls the threading tooth **50** toward its retracted position. Such position is notably visible on figure **9**.

[0066] In this example, the threading tooth **50** is mounted into a guide **51** fixed under flight **42**, so that the thread-

ing tooth moves in translation perpendicularly to the longitudinal axis X-X'.

[0067] As can be seen on figure **7**, the cutting head **20** further comprises a protection box **64** fixed to the bottom end of the hollow cylindrical core for receiving the gear **58**.

[0068] The protection box **64** surrounds a window **66** formed in the bottom end **34a** of the hollow cylindrical core **34**. In this example, the window **66** is disposed above the outlet tube **38**.

[0069] In addition, the rack **56** projects into the box through said window **66**.

[0070] When referring to figure **8**, it can be noted that the lever **60** and the connecting rod **62** are disposed outside of the protection box **64**. The protection box **64** is indeed designed for preventing soil to enter inside the box, so that the rack and the gear can work smoothly.

[0071] The rotation axis **A** of the gear **58** and lever **60** passes through a side wall of the protection box **64**.

[0072] Turning back to figure **7**, it is visible that the rack **56** presents a top **56a** and the window **66** presents also a top **66a**.

[0073] As can be seen on figure **13**, when the upper part **22** of the cutting head is raised, the top **56a** of the rack **56** comes into abutment with the top **66a** of the window **66** so as to limit the vertical relative displacement between the inner hollow tubular member **43** and the hollow cylindrical core **34**. In other words, in this example, the upper part is movable in translation relative to the lower part over a predetermined length.

[0074] Figures **11** and **12** show the gap which is created between the upper part **22** and the lower part **24** when the cutting head **20** is raised.

[0075] In another embodiment, the relative displacement between the upper part **22** and the lower part **24** is achieved differently: the inner hollow tubular member comprises a shoulder configured to come into vertical abutment with a top portion of the hollow cylindrical core so as to limit the relative displacement between the inner hollow tubular member **43** and the hollow cylindrical core **34**. Such configuration is notably illustrated in figure **20** of EP 1 748 108 the description of which is incorporated in the present application.

[0076] As previously mentioned, when the upper part **22** of the cutting head **20** is raised, the inner hollow tubular member **43** with the rack **56** moves upwards relative to the hollow cylindrical core **34** to which the protective box is attached. Upward movement of the rack **56** is limited by contact between the top **56a** of the rack **56** and the top **66a** of the window **66**. When the top **56a** of the rack **56** abuts against the top **66a** of the window **66**, the inner hollow tubular member **43** raises the hollow cylindrical core. In other words, the vertical displacement of the inner hollow tubular member causes the vertical displacement of the hollow cylindrical core.

[0077] When the rack **56** is in its uppermost position, the threading tooth **50** is fully extended as visible on figures **13**, **14** and **15**. Similarly, when the rack **56** is in its lowermost position, the threading tooth **50** is fully retract-

ed.

[0078] In addition, on completion of boring, concrete is delivered through said hollow cylindrical core and said inner hollow tubular member. During the upward movement of the cutting head **20**, the cap **40** is open and concrete is injected into the bore article flowing inside inner hollow tubular member **43**.

[0079] In this example, the cutting head **20** comprises a monitoring device **70** for monitoring the position of the threading tooth **50**. Preferentially, the monitoring device comprises a movement sensor **74** disposed in the protection box **64** for monitoring the movement of the rack **56**, and a data logger **72** connected to the movement sensor for recording the monitoring information provided by the movement sensor during the making of the pile.

[0080] The machine for making a threaded pile represented in figure **2** further comprises a computer **80** comprising means for downloading the information stored in the data logger after the making of the pile, and a display device **82** for displaying said information.

[0081] In this example, the monitoring device **70** is configured for monitoring in real time the position of the threading tooth **50** during the making of the pile. The computer **80** is connected to the monitoring device for instance by a wire or wireless connection so that the real time position of the threading tooth **50** appears on the display device.

Claims

1. A cutting head (20) comprising :

- a hollow cylindrical core (34) having a longitudinal axis (X-X') and a bottom end (34a);
- a helical flight (42) being mounted on an outside face of the hollow cylindrical core;
- a threading tooth (50) presenting an extended position in which the threading tooth projects outside a volume defined by the periphery of the flight and a retracted position in which the threading tooth is disposed inside said volume;
- displacement means (52) for displacing said threading tooth between said retracted position and said extended position, said displacement means comprising:

- an inner hollow tubular member (43) mounted to move into said hollow cylindrical core (34) in translation along said longitudinal axis and disposed at least at the bottom end (34a) of said hollow cylindrical core;
- control means (54) for causing said threading tooth to be displaced between said retracted position and said extended position in response to the translation of the inner hollow tubular member relative to at least the bottom end of said hollow cylindrical

core;

the cutting head being **characterized in that** the control means comprises:

- a rack (56) fixed to the inner hollow tubular member (43),
- at least a gear (58) cooperating with the rack, said gear being mounted on the bottom end of the hollow cylindrical core,
- a lever (60) connected to the gear;
- a connecting rod (62) pivotally connected to the lever and to the threading tooth, whereby the translation of the rack (56) causes the displacement of the threading tooth (50).

2. The cutting head according to claim **1**, wherein the threading tooth (50) is mounted to move in translation perpendicularly to the longitudinal axis (X-X').
3. The cutting head according to claim **1** or **2**, wherein it further comprises a protection box (64) fixed to the bottom end of the hollow cylindrical core for receiving the gear, said protection box surrounding a window (66) formed in the bottom end of the hollow cylindrical core, and wherein the rack projects into the protection box through said window.
4. The cutting head according to claim **3**, wherein the lever (60) and the connecting rod (62) are disposed outside of the protection box.
5. The cutting head according to any one of claims **1** to **4**, wherein it comprises means for limiting the relative vertical displacement between the inner hollow tubular member (43) and the hollow cylindrical core (34).
6. The cutting head according to claim **5**, wherein the rack (56) presents a top (56a), the windows (66) presents a top (66a), and wherein the top of the rack is configured to come into abutment with the top of the window so as to limit the relative vertical displacement between the inner hollow tubular member and the hollow cylindrical core.
7. The cutting head according to claim **5**, wherein the inner hollow tubular member (43) comprises a shoulder configured to come into vertical abutment with a top portion of the hollow cylindrical core so as to limit the relative displacement between the inner hollow tubular member and the hollow cylindrical core.
8. The cutting head according to any one of claims **1** to **7**, wherein the bottom end (34a) of the hollow cylindrical core (34) comprises a hinged cap (40) for closing the hollow cylindrical core during boring.

9. The cutting head according to any one of claims 1 to 8, wherein the threading tooth (50) extends ortho-radially in respect to the longitudinal axis.
10. The cutting head according to any one of claims 1 to 9, wherein it comprises an upper part (22) and a lower part (24), wherein the lower part comprises the hollow cylindrical core (34) and said control means (54), wherein the upper part has a lower end, wherein the inner hollow tubular member is fixed to the lower end of the upper part and extends along the length of the hollow cylindrical core, and wherein the upper part is movable in translation relative to the lower part over a predetermined length.
11. The cutting head according to claim 10, wherein it further comprises means (26) for constraining in rotation said upper part and lower part relative to each other.
12. The cutting head according to any one of claims 1 to 11, wherein it further comprises a monitoring device (70) for monitoring the position of the threading tooth (50).
13. The cutting head according to claims 3 and 12, wherein the monitoring device (70) comprises a movement sensor (74) disposed in the protection box (64) for monitoring the movement of the rack (56), and a data logger (74) connected to the movement sensor for recording the monitoring information provided by the movement sensor (74).
14. Machine (100) for making a threaded pile (10) in a soil (S) comprising a cutting head according to any one of claims 1 to 13.
15. Machine (100) according to claim 14, wherein said machine further comprises means (80) for downloading the information stored in the data logger after the making of the pile, and a display device (82) for displaying said information.
16. Machine (100) according to claim 14, wherein said machine further comprises a monitoring device for monitoring in real time the position of the threading tooth during the making of the pile, a computer (80) connected to the monitoring device, and a display device (82) connected to the computer for displaying in real time the position of the threading tooth.
17. Machine (100) according to any one of claims 14 to 16, wherein said machine further comprises a supply system (110) to deliver a liquid construction material through said hollow cylindrical core and said inner hollow tubular member.

Patentansprüche

1. Schneidkopf (20), umfassend:

- einen hohlen zylindrischen Kern (34) mit einer Längsachse (X-X') und einem unteren Ende (34a),
- einen spiralförmigen Schraubengang (42), der an einer Außenfläche des hohlen zylindrischen Kerns angebracht ist,
- einen Gewindeschneidzahn (50), der eine ausgefahrene Position, in welcher der Gewindeschneidzahn außerhalb eines Volumens, das durch den Umfang des Schraubengangs definiert wird, vorsteht, und eine eingefahrene Position, in welcher der Gewindeschneidzahn innerhalb des Volumens angeordnet ist, aufweist,
- ein Verlagerungsmittel (52) zum Verlagern des Gewindeschneidzahns zwischen der eingefahrenen Position und der ausgefahrenen Position, wobei das Verlagerungsmittel umfasst:
 - ein inneres hohles rohrförmiges Glied (43), das angebracht ist, um sich in einer Translationsbewegung entlang der Längsachse in den hohlen zylindrischen Kern (34) hinein zu bewegen, und mindestens an dem unteren Ende (34a) des hohlen zylindrischen Kerns angeordnet ist,
 - ein Steuermittel (54) zum Bewirken, dass der Gewindeschneidzahn in Abhängigkeit von der Translationsbewegung des inneren hohlen rohrförmigen Glieds relativ zu mindestens dem unteren Ende des hohlen zylindrischen Kerns zwischen der eingefahrenen Position und der ausgefahrenen Position verlagert wird,

wobei der Schneidkopf **dadurch gekennzeichnet ist, dass** das Steuermittel umfasst:

- eine Zahnstange (56), die an dem inneren hohlen rohrförmigen Glied (43) befestigt ist,
- mindestens ein Zahnrad (58), das mit der Zahnstange zusammenwirkt, wobei das Zahnrad an dem unteren Ende des hohlen zylindrischen Kerns angebracht ist,
- einen Hebel (60), der mit dem Zahnrad verbunden ist,
- eine Verbindungsstange (62), die schwenkbar mit dem Hebel und dem Gewindeschneidzahn verbunden ist, wodurch die Translationsbewegung der Zahnstange (56) die Verlagerung des Gewindeschneidzahns (50) bewirkt.

2. Schneidkopf nach Anspruch 1, wobei der Gewindeschneidzahn (50) angebracht ist, um sich in einer Translationsbewegung im rechten Winkel zu der Längsachse (X-X') zu bewegen.

3. Schneidkopf nach Anspruch 1 oder 2, wobei dieser

- ferner ein Schutzgehäuse (64) umfasst, das an dem unteren Ende des hohlen zylindrischen Kerns zum Aufnehmen des Zahnrads befestigt ist, wobei das Schutzgehäuse ein Fenster (66) umgibt, das in dem unteren Ende des hohlen zylindrischen Kerns ausgebildet ist, und wobei die Zahnstange durch das Fenster in das Schutzgehäuse vorsteht.
4. Schneidkopf nach Anspruch 3, wobei der Hebel (60) und die Verbindungsstange (62) außerhalb des Schutzgehäuses angeordnet sind.
 5. Schneidkopf nach einem beliebigen der Ansprüche 1 bis 4, wobei dieser ein Mittel zum Begrenzen der relativen senkrechten Verlagerung zwischen dem inneren hohlen rohrförmigen Glied (43) und dem hohlen zylindrischen Kern (34) umfasst.
 6. Schneidkopf nach Anspruch 5, wobei die Zahnstange (56) ein oberes Ende (56a) aufweist, das Fenster (66) ein oberes Ende (66a) aufweist, und wobei das obere Ende der Zahnstange dazu ausgebildet ist, mit dem oberen Ende des Fensters in Anlage zu kommen, um die relative senkrechte Verlagerung zwischen dem inneren hohlen rohrförmigen Glied und dem hohlen zylindrischen Kern zu begrenzen.
 7. Schneidkopf nach Anspruch 5, wobei das innere hohle rohrförmige Glied (43) eine Schulter umfasst, die dazu ausgebildet ist, mit einem oberen Abschnitt des hohlen zylindrischen Kerns in senkrechte Anlage zu kommen, um die relative Verlagerung zwischen dem inneren hohlen rohrförmigen Glied und dem hohlen zylindrischen Kern zu begrenzen.
 8. Schneidkopf nach einem beliebigen der Ansprüche 1 bis 7, wobei das untere Ende (34a) des hohlen zylindrischen Kerns (34) eine angelenkte Kappe (40) zum Verschließen des hohlen zylindrischen Kerns während des Bohrens umfasst.
 9. Schneidkopf nach einem beliebigen der Ansprüche 1 bis 8, wobei sich der Gewindeschneidzahn (50) in Bezug auf die Längsachse orthoradial erstreckt.
 10. Schneidkopf nach einem beliebigen der Ansprüche 1 bis 9, wobei dieser einen oberen Teil (22) und einen unteren Teil (24) umfasst, wobei der untere Teil den hohlen zylindrischen Kern (34) und das Steuermittel (54) umfasst, wobei der obere Teil ein unteres Ende aufweist, wobei das innere hohle rohrförmige Glied an dem unteren Ende des oberen Teils befestigt ist und sich entlang der Länge des hohlen zylindrischen Kerns erstreckt, und wobei der obere Teil in einer Translationsbewegung über eine vorgegebene Länge relativ zu dem unteren Teil bewegbar ist.
 11. Schneidkopf nach Anspruch 10, wobei dieser ferner ein Mittel (26) zum Beschränken der Rotation des oberen Teils und des unteren Teils relativ zueinander umfasst.
 12. Schneidkopf nach einem beliebigen der Ansprüche 1 bis 11, wobei dieser ferner eine Überwachungs- vorrichtung (70) zum Überwachen der Position des Gewindeschneidzahns (50) umfasst.
 13. Schneidkopf nach Anspruch 3 und 12, wobei die Überwachungs- vorrichtung (70) einen Bewegungssensor (74), der in dem Schutzgehäuse (64) zur Überwachung der Bewegung der der Zahnstange (56) angeordnet ist, und einen Datenlogger (74), der mit dem Bewegungssensor zum Aufzeichnen der durch den Bewegungssensor (74) bereitgestellten Überwachungsinformationen verbunden ist, umfasst.
 14. Maschine (100) zum Herstellen eines Schraubpfahls (10) in einem Boden (S), umfassend einen Schneidkopf nach einem beliebigen der Ansprüche 1 bis 13.
 15. Maschine (100) nach Anspruch 14, wobei die Maschine ferner ein Mittel (80) zum Herunterladen der Informationen, die in dem Datenlogger gespeichert sind, nach dem Herstellen des Pfahls und eine Anzeigevorrichtung (82) zum Anzeigen der Informationen umfasst.
 16. Maschine (100) nach Anspruch 14, wobei die Maschine ferner eine Überwachungs- vorrichtung zum Überwachen der Position des Gewindeschneidzahns in Echtzeit während des Herstellens des Pfahls, einen Rechner (80), der mit der Überwachungs- vorrichtung verbunden ist, und eine Anzeigevorrichtung (82), die mit dem Rechner verbunden ist, zum Anzeigen der Position des Gewindeschneidzahns in Echtzeit umfasst.
 17. Maschine (100) nach einem beliebigen der Ansprüche 14 bis 16, wobei die Maschine ferner ein Zufuhrsystem (110) umfasst, um durch den hohlen zylindrischen Kern und das innere hohle rohrförmige Glied ein flüssiges Baumaterial zuzuführen.

Revendications

1. Tête de coupe (20) comportant :
 - une âme cylindrique creuse (34) ayant un axe longitudinal (X-X') et une extrémité inférieure (34a) ;
 - un filet hélicoïdal (42) monté sur une face extérieure de l'âme cylindrique creuse ;
 - une dent de filetage (50) présentant une position sortie dans laquelle la dent de filetage dé-

passer à l'extérieur d'un volume défini par la périphérie du filet et une position rentrée dans laquelle la dent de filetage est disposée à l'intérieur dudit volume ;

• des moyens de déplacement (52) destinés à déplacer ladite dent de filetage entre ladite position rentrée et ladite position sortie, lesdits moyens de déplacement comportant :

- un élément tubulaire creux intérieur (43) monté pour se déplacer dans ladite âme cylindrique creuse (34) en translation le long dudit axe longitudinal et disposé au moins à l'extrémité inférieure (34a) de ladite âme cylindrique creuse ;
- des moyens de commande (54) destinés à déplacer ladite dent de filetage entre ladite position rentrée et ladite position sortie en réponse à la translation de l'élément tubulaire creux intérieur par rapport à au moins l'extrémité inférieure de ladite âme cylindrique creuse ;

la tête de coupe étant **caractérisée en ce que** les moyens de commande comportant :

- une crémaillère (56) fixée sur l'élément tubulaire creux intérieur (43),
- au moins un pignon (58) qui coopère avec la crémaillère, ledit pignon étant monté sur l'extrémité inférieure de l'âme cylindrique creuse,
- un levier (60) relié au pignon ;
- une bielle (62) reliée de façon pivotante au levier et à la dent de filetage, de sorte que la translation de la crémaillère (56) provoque le déplacement de la dent de filetage (50).

2. Tête de coupe selon la revendication 1, dans laquelle la dent de filetage (50) est montée pour se déplacer en translation perpendiculairement à l'axe longitudinal (X-X').

3. Tête de coupe selon la revendication 1 ou 2, dans laquelle elle comporte en outre une boîte de protection (64) fixée à l'extrémité inférieure de l'âme cylindrique creuse afin de recevoir le pignon, ladite boîte de protection entourant une fenêtre (66) formée dans l'extrémité inférieure de l'âme cylindrique creuse, et dans laquelle la crémaillère fait saillie dans la boîte de protection à travers ladite fenêtre.

4. Tête de coupe selon la revendication 3, dans laquelle le levier (60) et la bielle (62) sont disposés à l'extérieur de la boîte de protection.

5. Tête de coupe selon l'une quelconque des revendications 1 à 4, dans laquelle elle comporte des

moyens destinés à limiter le déplacement vertical relatif entre l'élément tubulaire creux intérieur (43) et l'âme cylindrique creuse (34).

6. Tête de coupe selon la revendication 5, dans laquelle la crémaillère (56) présente un dessus (56a), les fenêtres (66) présentent un dessus (66a), et dans laquelle le dessus de la crémaillère est configuré pour venir en butée avec le dessus de la fenêtre de façon à limiter le déplacement vertical relatif entre l'élément tubulaire creux intérieur et l'âme cylindrique creuse.

7. Tête de coupe selon la revendication 5, dans laquelle l'élément tubulaire creux intérieur (43) comporte un épaulement configuré pour venir en butée verticale avec une partie supérieure de l'âme cylindrique creuse de façon à limiter le déplacement relatif entre l'élément tubulaire creux intérieur et l'âme cylindrique creuse.

8. Tête de coupe selon l'une quelconque des revendications 1 à 7, dans laquelle l'extrémité inférieure (34a) de l'âme cylindrique creuse (34) comporte un chapeau articulé (40) destiné à fermer l'âme cylindrique creuse pendant un forage.

9. Tête de coupe selon l'une quelconque des revendications 1 à 8, dans laquelle la dent de filetage (50) s'étend de manière orthoradiale par rapport à l'axe longitudinal.

10. Tête de coupe selon l'une quelconque des revendications 1 à 9, dans laquelle elle comporte une partie supérieure (22) et une partie inférieure (24), dans laquelle la partie inférieure comporte l'âme cylindrique creuse (34) et lesdits moyens de commande (54), dans laquelle la partie supérieure a une extrémité inférieure, dans laquelle l'élément tubulaire creux intérieur est fixé sur l'extrémité inférieure de la partie supérieure et s'étend sur la longueur de l'âme cylindrique creuse, et dans laquelle la partie supérieure est mobile en translation par rapport à la partie inférieure sur une longueur prédéterminée.

11. Tête de coupe selon la revendication 10, dans laquelle elle comporte en outre des moyens (26) destinés à retenir en rotation ladite partie supérieure et ladite partie inférieure l'une par rapport à l'autre.

12. Tête de coupe selon l'une quelconque des revendications 1 à 11, dans laquelle elle comporte en outre un dispositif de surveillance (70) destinés à surveiller la position de la dent de filetage (50).

13. Tête de coupe selon les revendications 3 et 12, dans laquelle le dispositif de surveillance (70) comporte

un capteur de mouvement (74) disposé dans la boîte de protection (64) pour surveiller le mouvement de la crémaillère (56), et un enregistreur de données (74) relié au capteur de mouvement pour enregistrer l'information de surveillance fournie par le capteur de mouvement (74). 5

14. Machine (100) destinée à fabriquer un pieu fileté (10) dans un sol (S) comportant une tête de coupe selon l'une quelconque des revendications 1 à 13. 10
15. Machine (100) selon la revendication 14, dans laquelle ladite machine comporte en outre des moyens (80) destinés à télécharger l'information stockée dans l'enregistreur de données après la fabrication du pieu, et un dispositif d'affichage (82) destiné à afficher ladite information. 15
16. Machine (100) selon la revendication 14, dans laquelle ladite machine comporte en outre un dispositif de surveillance destiné à surveiller en temps réel la position de la dent de filetage pendant la fabrication du pieu, un ordinateur (80) relié au dispositif de surveillance, et un dispositif d'affichage (82) relié à l'ordinateur afin d'afficher en temps réel la position de la dent de filetage. 20 25
17. Machine (100) selon l'une quelconque des revendications 14 à 16, dans laquelle ladite machine comporte en outre un système d'alimentation (110) destiné à délivrer un matériau de construction liquide à travers ladite âme cylindrique creuse et ledit élément tubulaire creux intérieur. 30

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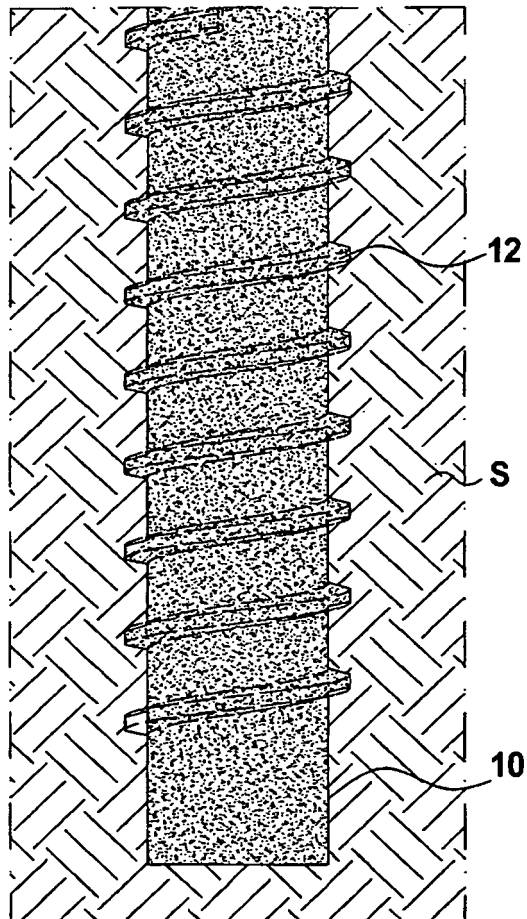


FIG.1

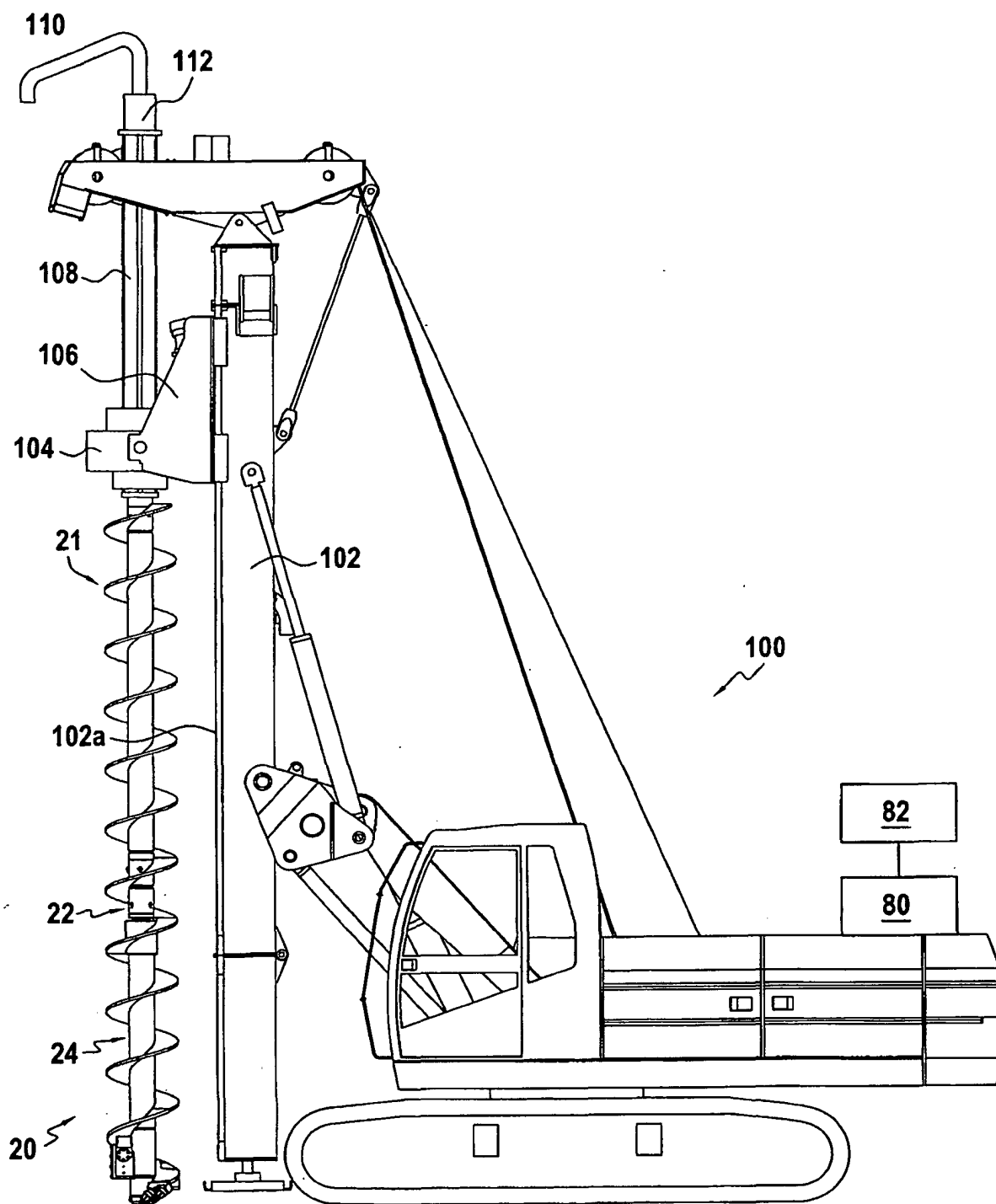


FIG.2

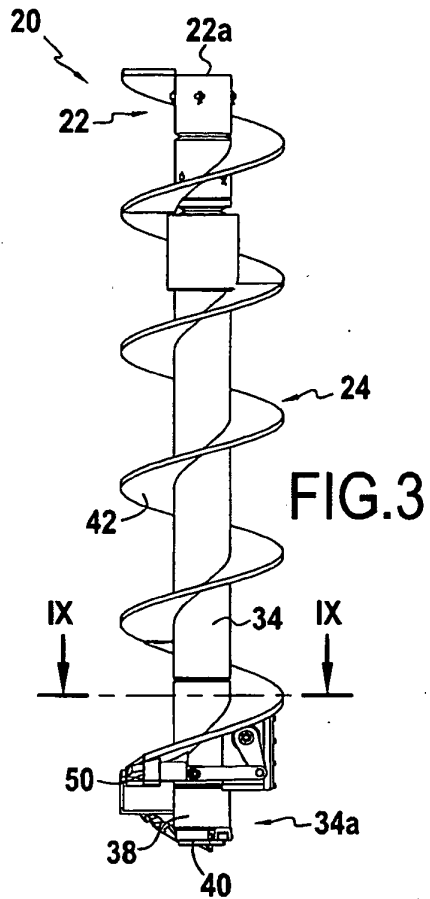
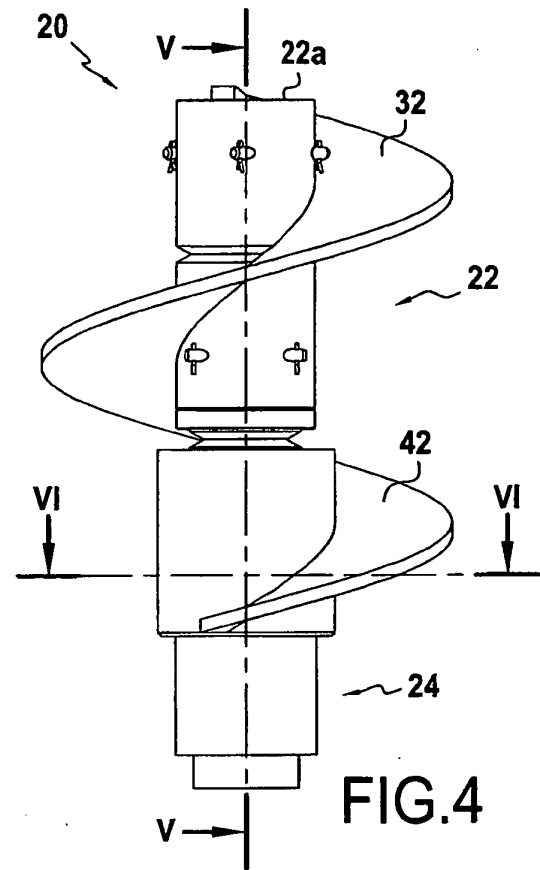
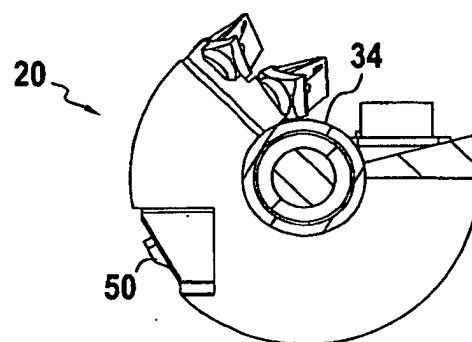
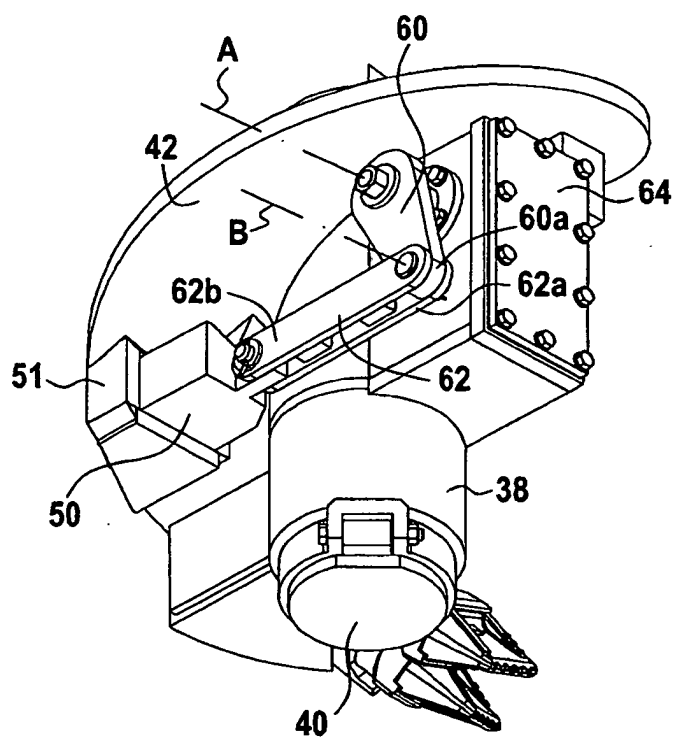
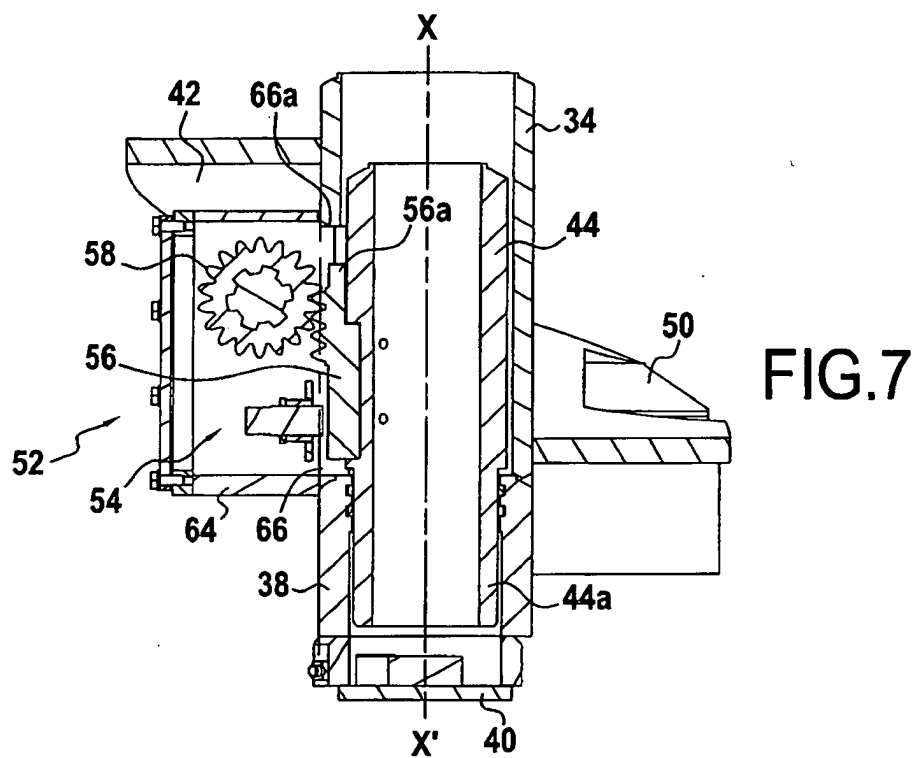
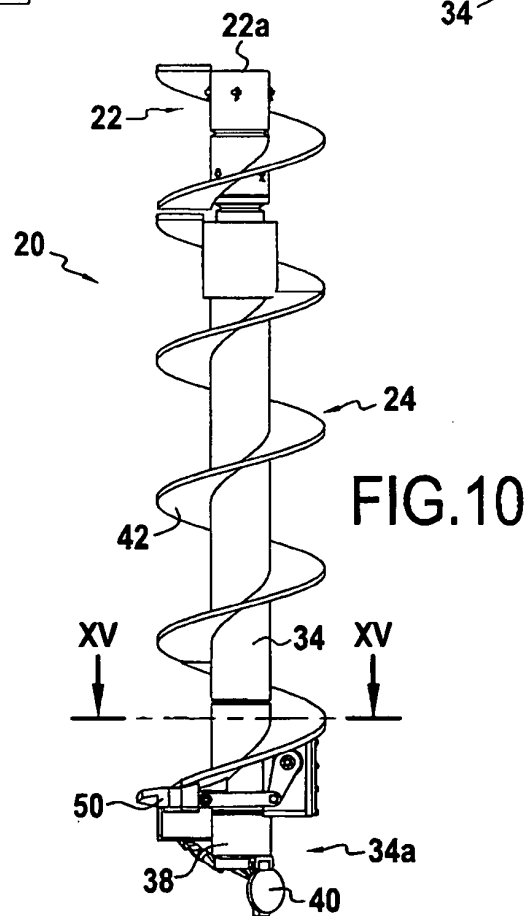
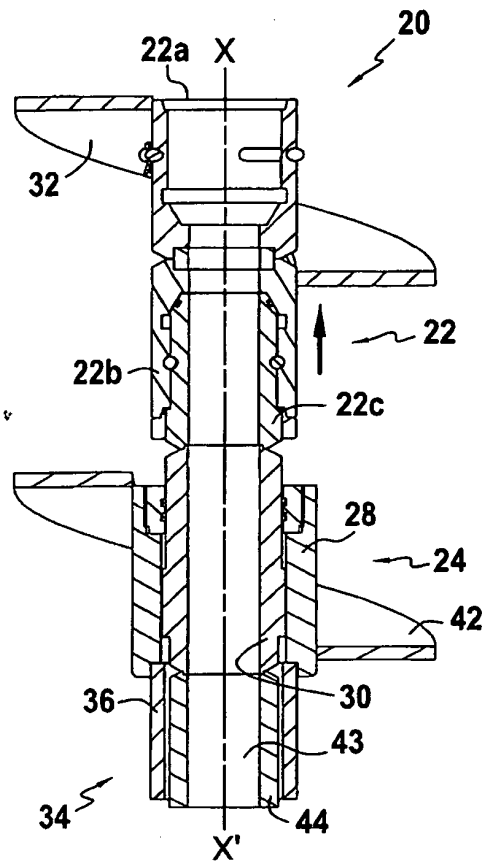
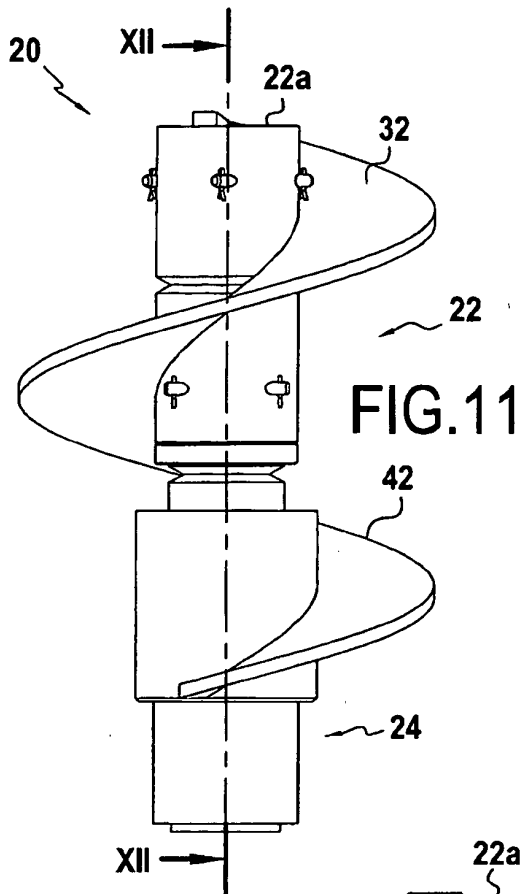
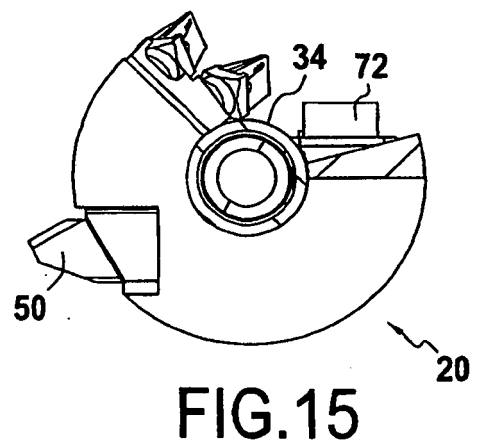
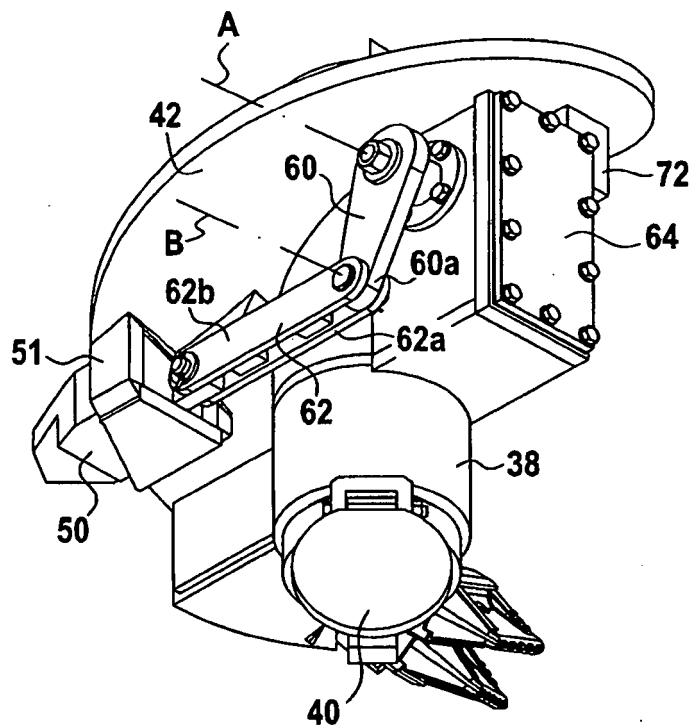
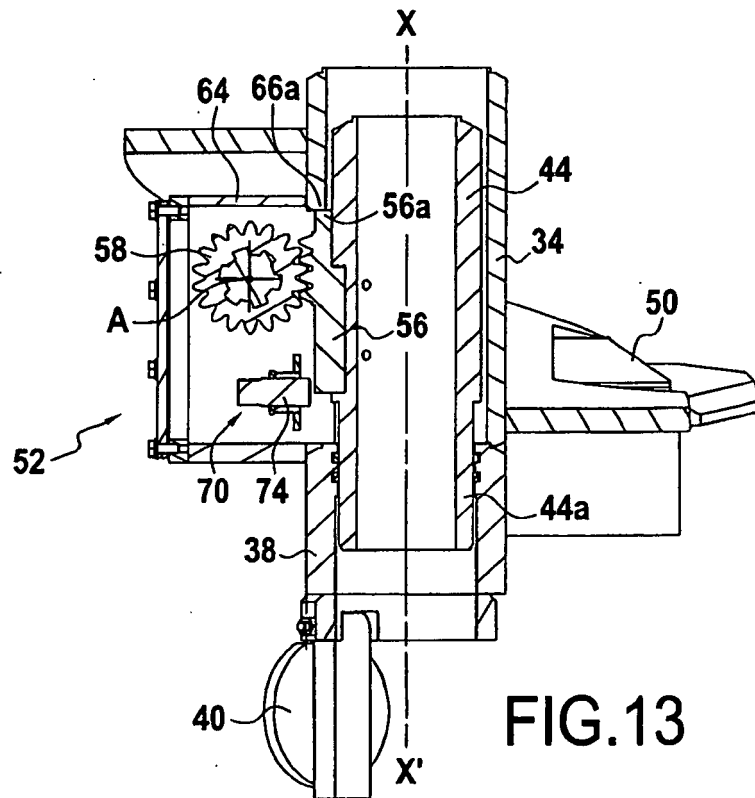


FIG.3









REFERENCES CITED IN THE DESCRIPTION

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