(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 471 187 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.10.2004 Bulletin 2004/44

(51) Int Cl.[7]: **E02D 5/56**

(21) Application number: **04291004.2**

(22) Date of filing: **15.04.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **22.04.2003 GB 0309090**

(71) Applicant: **COMPAGNIE DU SOL**
92000 Nanterre (FR)

(72) Inventors:
- **Stansfield, Lewis**
  92000 Nanterre (FR)
- **Wharmby, Nick**
  92000 Nanterre (FR)

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

(54) Threading equipment

(57) The invention relates to a threading equipment for cutting a thread in the inner face of a shaft.

The equipment comprises a displaceable assembly comprising an upper section including at least one cutting means (52,54) and control means to move said at least one cutting means from a retracted position, wherein said at least one cutting means is disposed within said shaft, to an expanded position, wherein said at least one cutting means projects into the wall of the shaft; means for controlling the vertical displacement speed of said displaceable assembly within said shaft; and means for controlling the rotation speed and the sense of rotation of said assembly about its vertical axis within said shaft, whereby said at least one cutting means is adapted to cut at least one thread in the surface of said shaft having a controlled pitch along a controlled length of said shaft, when said at least one cutting means is in its expanded position.

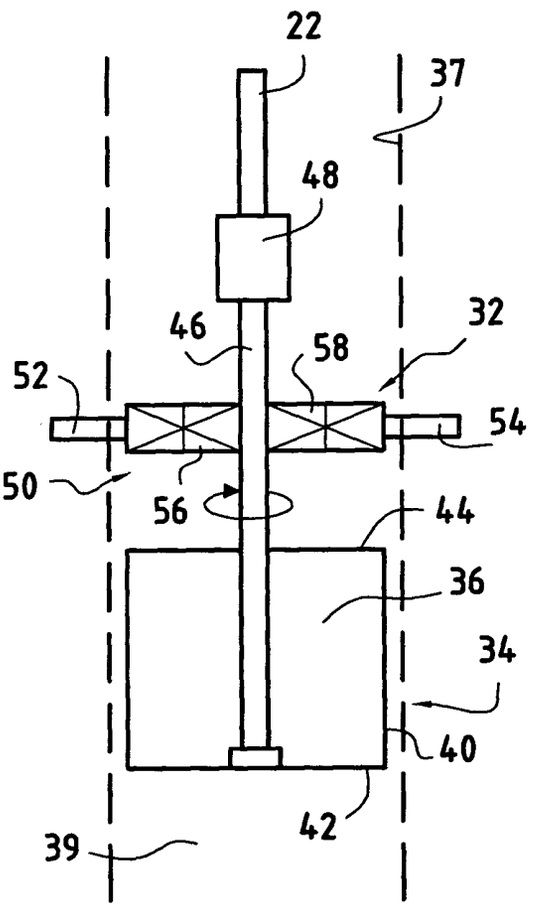

FIG.2

EP 1 471 187 A1

Description

[0001] The present invention relates to a threading equipment for cutting an internal thread inside a previously bored pile shaft, said shaft being preferably, but not necessarily, bored in clay or similar soil. The equipment may further comprise a bucket.

[0002] When making concrete piles in the 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 drilling operation is lowered.

[0003] 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 of a given diameter is to make a thread or an helical slot in the internal wall of the pile shaft. When the pile shaft is filled with concrete to obtain the pile, the thread or helical slot is also filled with concrete.

[0004] EP 1 277 887 in the name of Compagnie du Sol describes a drilling tool which is provided with a cutter. This cutter projects outside the lower end of the flight of this tool. When the tool is rotated and lifted the cutter makes a helical slot or thread in the inner wall of the pile shaft bored by the drilling tool itself. However, this technique is only usable when the tool is of the horizontal displacement type.

[0005] An object of the present invention is to provide an equipment which permits the cutting of an internal thread inside a previously bored pile shaft, especially when the pile shaft is bored in clay or similar soil.

[0006] To achieve this object, according to the present invention, the threading bucket equipment for cutting a thread in the inner wall of a shaft comprises:

- a displaceable assembly comprising an upper section including at least one cutting member and control means to move said at least one cutting means from a retracted position, wherein said at least one cutting means is disposed within said shaft to an expanded position wherein said at least one cutting means projects outside said shaft and cuts the wall of the shaft;
- means for controlling the vertical displacement speed of said displaceable assembly within said shaft; and
- means for controlling the rotation speed and the sense of rotation of said assembly about its vertical axis within said shaft, whereby said at least one cutting means is adapted to cut at least one thread in the surface of said shaft having a controlled pitch along a controlled length of said shaft, when said at least one cutting means is in its expanded position.

[0007] It will be understood that, during the downward displacement of the displaceable assembly within the shaft, the cutting member is in its retracted position. When the assembly reaches the bottom of the shaft the cutting member is moved to its expanded position. Then the displaceable assembly is raised and rotated whereby the cutting member makes the thread or helical slot in the internal wall of the pile shaft.

[0008] Preferably, the displaceable assembly further comprises a lower section secured to the upper section, said lower section forming a cylindrical container for receiving the soil cuttings.

[0009] Advantageously, the displaceable assembly is fixed at the lower end of the driving rods. When the driving rods are rotated in a first direction the cutting member is in its retracted position and when the driving rods are rotated in the second direction the cutting member is in its expanded active position.

[0010] The pitch of the thread and the length of the thread can be predetermined by controlling the rotation speed and vertical displacement speed of the displaceable assembly.

[0011] Also advantageously, the displaceable assembly is provided with means, for example drag plates, to create a friction force between the displaceable assembly and the inner wall of the pile shaft whereby the sense of rotation of the driving rods can efficiently move the cutting member from its retracted position to its expanded position.

[0012] Other features or advantages of the present invention will appear clearer on reading the following description of several preferred embodiments of the invention given by way of non-limiting example.

[0013] The description refers to the accompanying figures in which :

- fig. 1 is a simplified view of the whole threading equipment;
- figs. 2 and 3 are simplified vertical sectional views of the threading equipment showing the cutting member in retracted and expanded position;
- figs. 4A and 4B are detailed horizontal views of the threading equipment showing the cutting member in expanded position and retracted position;
- fig. 5 is a vertical sectional view of the threading equipment;
- fig. 6 is an example of a pile obtained by using the threading equipment; and
- fig. 7 shows a cutting tool adapted to be used with the threading equipment.

[0014] Referring firstly to fig. 1, the main parts of the threading equipment will be described.

[0015] The equipment comprises a piling rig 10 provided with a vertical mast 12. The upper end 12a of the mast is equipped with two pulleys 14, 16 for a cable 18. The mast 12 also forms a vertical guide for a movable rotary drive box 20. The rotary drive box 20 can be moved along the whole length of the mast 12. The equipment further comprises a set of driving rods or Kelly bar 22. The Kelly bar consists of a plurality of steel tubes which are locked one to the other. The upper end 22a of the Kelly bar is secured to an end of the cable 18. As

a result, the up and down vertical movement of the Kelly bar is controlled by the cable.

[0016] The Kelly bar 22 passes through the rotary drive box 20 and the box 20 applies a rotative torque to the Kelly bar 22. However, the Kelly bar can be vertically moved with respect to the box 20.

[0017] The lower end 22b of the Kelly bar or of the driving rods is connected to a threading equipment 30 or displaceable assembly. The threading equipment 30 preferably comprises an upper section 32 and a lower section 34 which are interconnected. The upper section 32 will be described in greater detail hereinafter. The lower section 34 is in the form of a cylindrical container 36 for catching the clay or soil cuttings as they fall from the upper section 32 which consists of a cutting device 38 adapted to cut a thread or helical slot in the internal wall 37 of a previously bored pile shaft 39.

[0018] The equipment further comprises speed transducers (not shown) to measure the vertical displacement speed and the rotational speed of the driving rods 22.

[0019] Referring now to figures 2 and 3, the principle of a threading bucket 30 equipment is described hereunder. The lower section 34 consists of a cylindrical container 36 having a cylindrical lateral wall 40, a bottom, 42 and an opened upper end 44.

[0020] The bottom 42 is secured to a rotating control axis 46, the upper end of which is connected by a linking member 48 to the lower end of the driving rods.

[0021] The upper section 50 consists of a threading equipment. The threading equipment comprises two cutting tools 52 and 54 diametrically opposed about the vertical control axis 46. Each cutting tool is linked to the axis 46 by a control mechanism 56 and 58. The control mechanisms are designed so that each cutting tool 52 or 54 can be moved, in a plane substantially perpendicular to the axis 46, between a retracted position shown in figure 3 and an expanded position shown in figure 2. More precisely, when the axis is rotated in the direction of arrow F1, the cutting tools are moved into their expanded position and when the axis 46 is rotated in the direction of arrow F2, the cutting tools are moved into their retracted position.

[0022] The theoretical embodiment shown in figures 2 and 3 allows the operation of the threading bucket equipment to be understood.

[0023] When the displaceable assembly 30 is moved downwardly in the bored shaft 39 the driving rods are rotated in the direction F2 so that the cutting member 50 is maintained in its retracted position. When the assembly 30 reaches the bottom of the shaft 39 the rods 22 are rotated in the direction F1 so that the cutting tools 52 and 54 are moved and maintained in their expanded position. Then the assembly is lifted with controlled vertical and rotational speeds so that the tool 50 cuts in the wall 37 of the bore 39 a thread having the shape of an helical slot. The thread has a pitch which is defined by the vertical and rotational speeds. This pitch can be varied along the length of the bored shaft. The thread can extend only along a lower portion of the shaft. The assembly 30 is rotated in the direction F2 when the thread is terminated.

[0024] The soil cuttings fall into the cylindrical container 36. The thread can be formed in one or several sections depending on the capacity of the container 36. As previously explained, the threading equipment can have no lower section, i.e. no bucket.

[0025] Fig. 6 shows a shaft 39, the wall 37 of which is provided with a thread or helical slot 58. The shape of the thread is defined by the shape of the cutting tool 50. The threading bucket can be equipped with two diametrically opposed cutting tools. Thus, a double helical slot is obtained.

[0026] Referring now to figs. 4A, 4B and 5, a preferred embodiment wherein the threading equipment is provided with a bucket will be described in detail. This equipment is called a threading bucket. According to this preferred embodiment the threading bucket numbered 60 is provided with means to create a friction force between the threading equipment and the wall of the shaft. This friction force permits the actual movement of the cutting member with respect to the frame of the equipment in its expanded position and its retracted position.

[0027] The cutting device 62 comprises two diametrically disposed cutting systems 64 and 66. These two cutting systems are identical, so only cutting system 64 will be described.

[0028] The cutting system 64 comprises a vertical drive tube 68 which is attached to the lower end 22b of the Kelly bar 22. Drive brackets 70 are secured to the drive tube 68. Linking levers 72 have a first end 72a which is pivotally mounted on the end 70a of the drive brackets 70. The second end 72b of the linking levers 72 is pivotally mounted on the median portion 74a of a cutting frame 74. In a horizontal plane, the cutting frame 74 has the shape of an arc of a circle. A first end 74b of the cutting frame 74 is pivotally mounted at the end 76a of upper drag bracket 76. The upper drag brackets 76 are secured to a drag tube 78 which is mounted around the outside of the drive tube 68. The drag tube 78 can rotate around the drive tube 68, thus allowing the drag brackets 76 to rotate relative to the drive brackets 70.

[0029] Lower drag brackets 77 are also secured to the drag tube 78. The end 77a of the lower drag brackets 77 is equipped with a drag plate 80. The drag plate 80 has the general shape of a portion of cylinder and is mounted on the drag bracket 76 by means of a biasing spring 82.

[0030] The second end 74C of the cutting frame 74 is provided with a tool holder 84 for receiving the cutting tool or cutting teeth 86. The cutting tool 86 projects outside the external face 74d of the cutting frame 74.

[0031] As shown in figure 5, the drag plate 80 is disposed below the cutting tool 86.

[0032] The drag plate 80 is positioned so as to be in firm contact with the inner wall 37 of the shaft under the

effect of the biasing spring 82 when the threading equipment is introduced into the upper end of the shaft.

[0033] Due to the friction force created between the drag plate 80 and the wall of the shaft, when the drive tube 68 is rotated in a counter-clockwise direction (fig. 4B) the drive bracket 70 is also rotated and the cutting frame 74 is pivoted about the end 76b of the drag bracket 76, towards the inner part of the threading bucket by means of the linking lever 72. Consequently, the cutting tool 86 is moved and maintained in its retracted position.

[0034] Also due to the friction force, when the drive tube 68 is rotated in the clockwise direction (figure 4A), the drive bracket 70 is also rotated. The rotation of the drive bracket 70 produces the outwardly pivotal movement of the cutting frame 74 about its ends 74b by means of the linking lever 72. Consequently, the cutting tool 86 is moved in its expanded position. Moreover, when the cutting tools 86 begin to bite into the soil, they themselves will provide additional resistance to rotation to keep them in their expanded position at their maximum diameter.

[0035] When the thread has been completed or the cylindrical container 34 has been filled with soil cuttings, the threading bucket is rotated in a counter-clockwise direction to retract the cutting tools 86, thus allowing it to be removed from the shaft.

[0036] Typically, the threading equipment is lifted 800 mm for each rotation, thereby forming a double helix with a pitch of 800 mm and a distance between two threads of 400 mm.

Claims

1. A threading equipment for cutting a thread in the inner face of a shaft comprising :

- a displaceable assembly comprising :

  an upper section including at least one cutting member and control means to move said at least one cutting means from a retracted position, wherein said at least one cutting means is disposed within said shaft, to an expanded position, wherein said at least one cutting means projects into the wall of the shaft;

- means for controlling the vertical displacement speed of said displaceable assembly within said shaft; and
- means for controlling the rotation speed and the sense of rotation of said assembly about its vertical axis within said shaft, whereby said at least one cutting means is adapted to cut at least one thread in the surface of said shaft having a controlled pitch along a controlled length of said shaft, when said at least one cutting means is in its expanded position.

2. The threading equipment of claim 1, wherein said displaceable assembly further comprises a lower section connected to said upper section, said lower section forming a cylindrical container.

3. The threading bucket equipment of claim 1 or 2, wherein said means for controlling the displacements of said displaceable assembly comprises :

- a plurality of driving rods said displaceable assembly being connected to the lower end of said rods;
- means for rotating said rods at a controlled speed and in a clockwise direction or a counter-clockwise direction ; and
- means for vertically moving said rods at a controlled speed.

4. The threading equipment according to any one of claims 1 to 3, wherein said upper section further comprises means for creating a friction force between said upper section and the inner surface of said shaft.

5. The threading equipment according to claim 4, wherein said means for moving said at least one cutting means comprises mechanical linking means having a first end connected to said at least one cutting means and a second end cinematically connected to the lower rods so that said cutting means be in its expanded rotation when said rods are rotated in a first direction and in its retracted position when said rods are rotated in the second direction.

6. The threading equipment of any one of claims 1 to 5, wherein said at least one cutting means is moved, between its retracted and expanded position, within a plane substantially perpendicular to the longitudinal axis of the displaceable assembly.

7. The threading equipment of claim 4, wherein said means for creating a friction force includes at least two moveable drag plates biased by two biasing means.

8. The threading equipment of claim 5, wherein said mechanical linking means comprises :

- a drive tube secured to said rods;
- a drag tube mounted around said drive tube;
- a support member for supporting said cutting means having a first end secured to said drive tube, said cutting means being secured to said support member at a place distinct from said first end;

  a drive bracket secured to said drive tube;

- a lever member having a first end pivotally mounted at the end of said bracket and a second end pivotally mounted on said support member at a place distinct from said first end.

9. The threading equipment of claim 8 further comprising two drag brackets secured to said drag tube and two drag plates, each drag plate being mounted at the end of a drag bracket by means of biasing springs.

10. The threading equipment of any one of claims 1 to 9, wherein said at least one cutting means is a cutter the active end of which has in vertical section the shape of the profile of the thread to be cut in the surface of the shaft.

11. The threading equipment according to any one of claims 1 to 10 comprising two cutting means diametrically opposed.

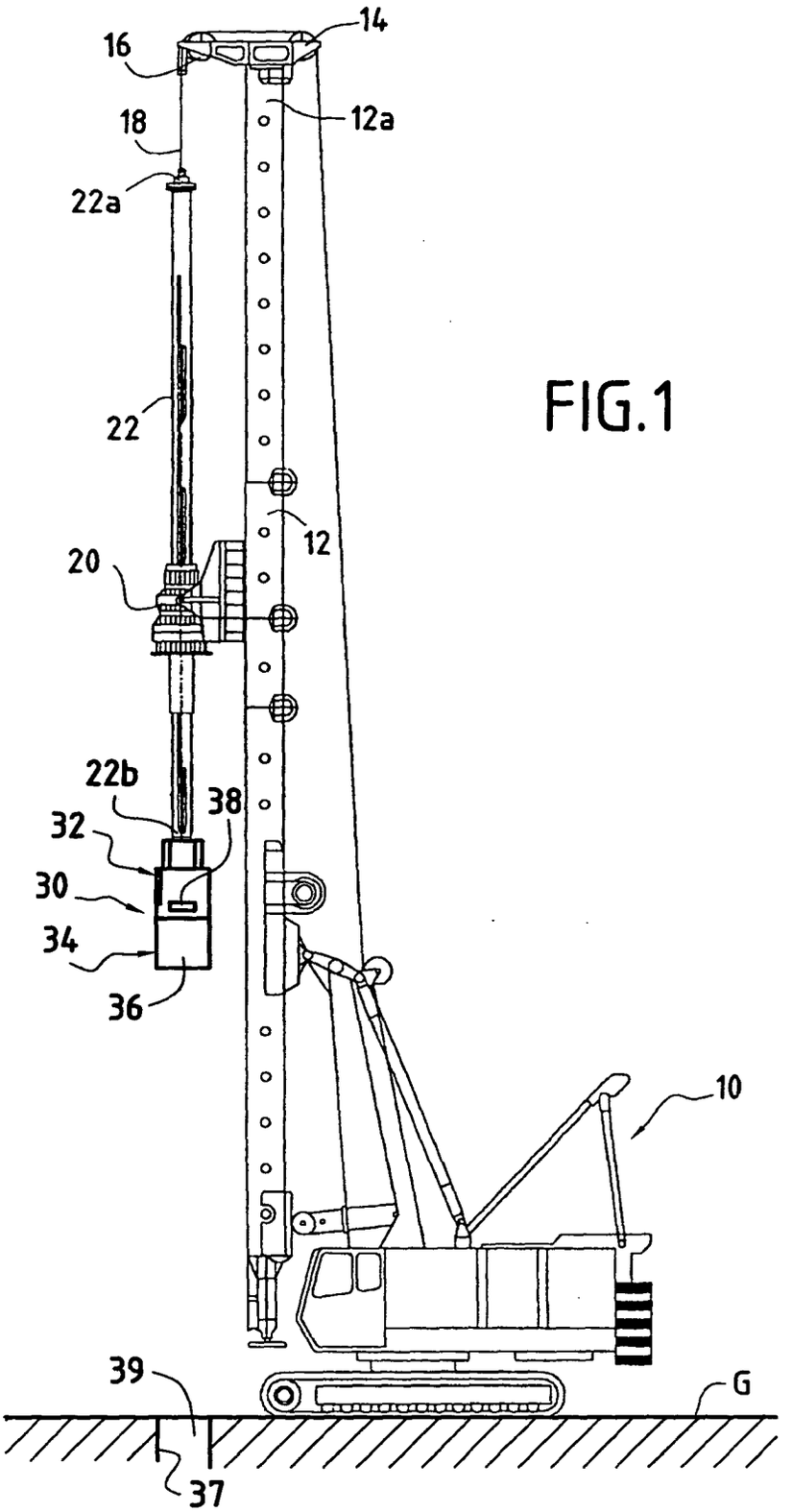

FIG.1

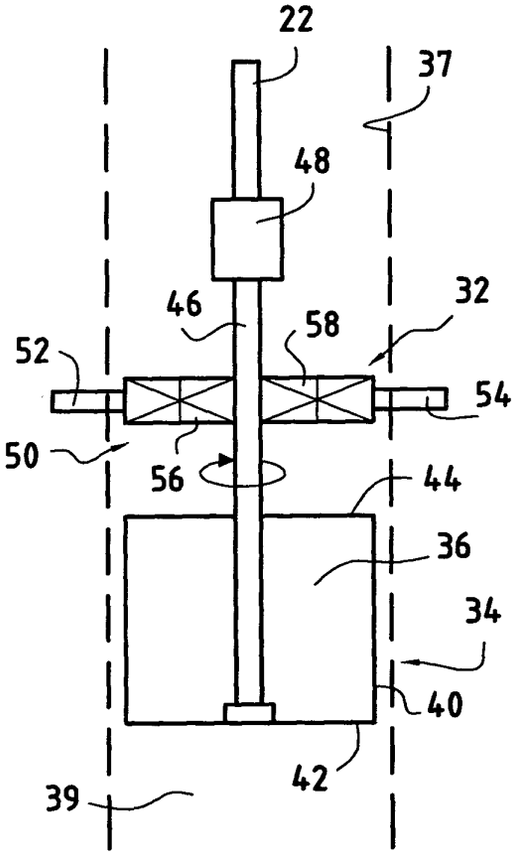

FIG.2

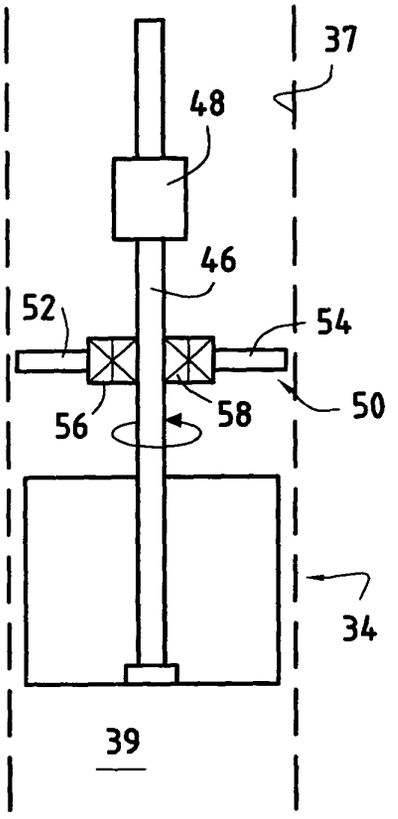

FIG.3

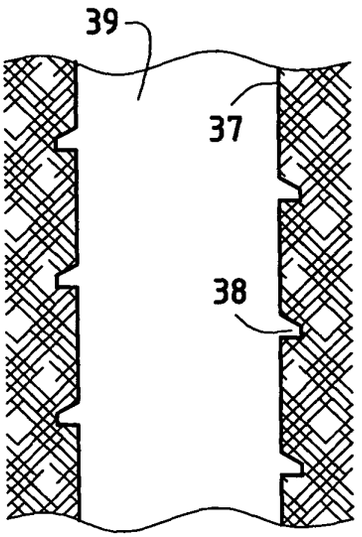

FIG.6

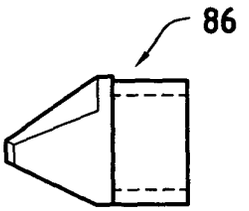

FIG.7

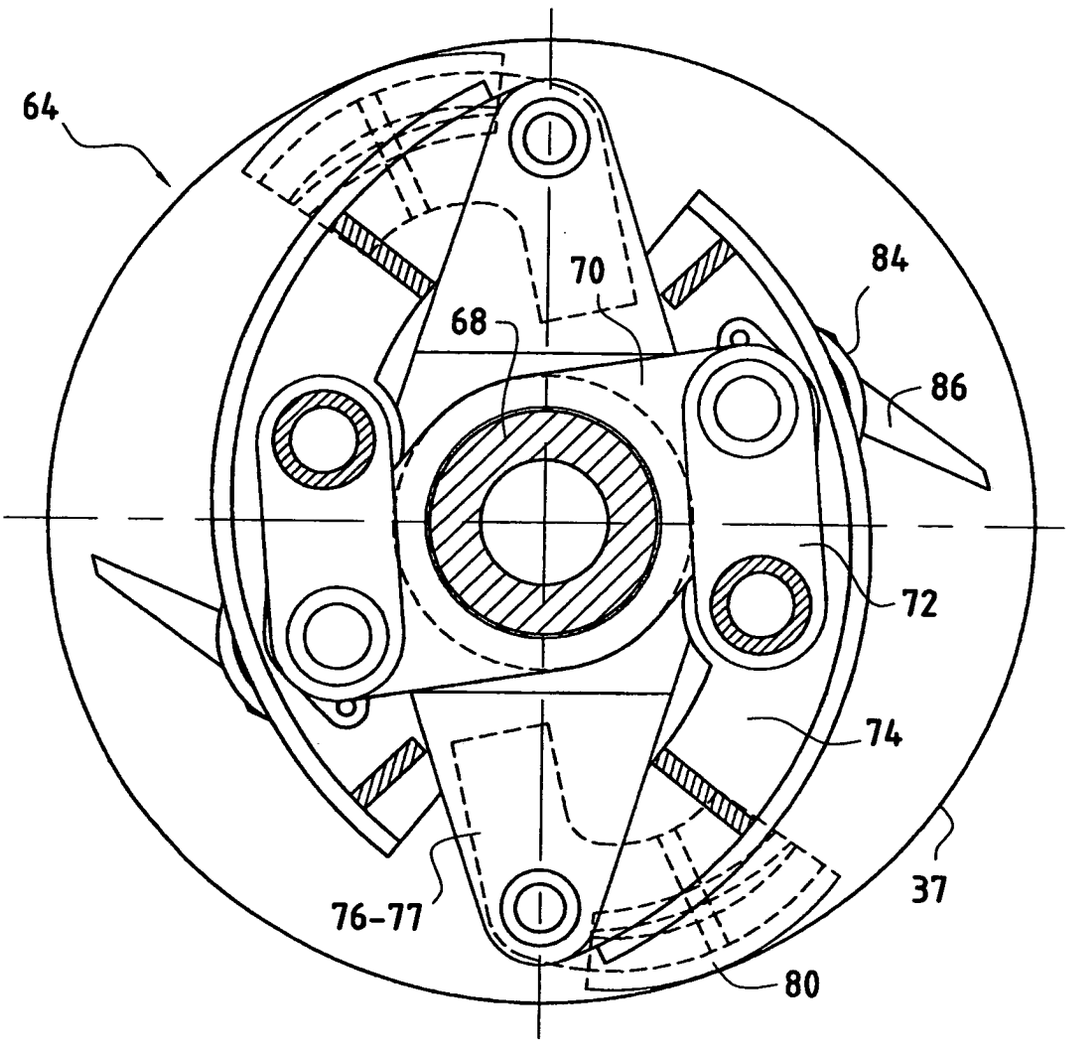

FIG.4B

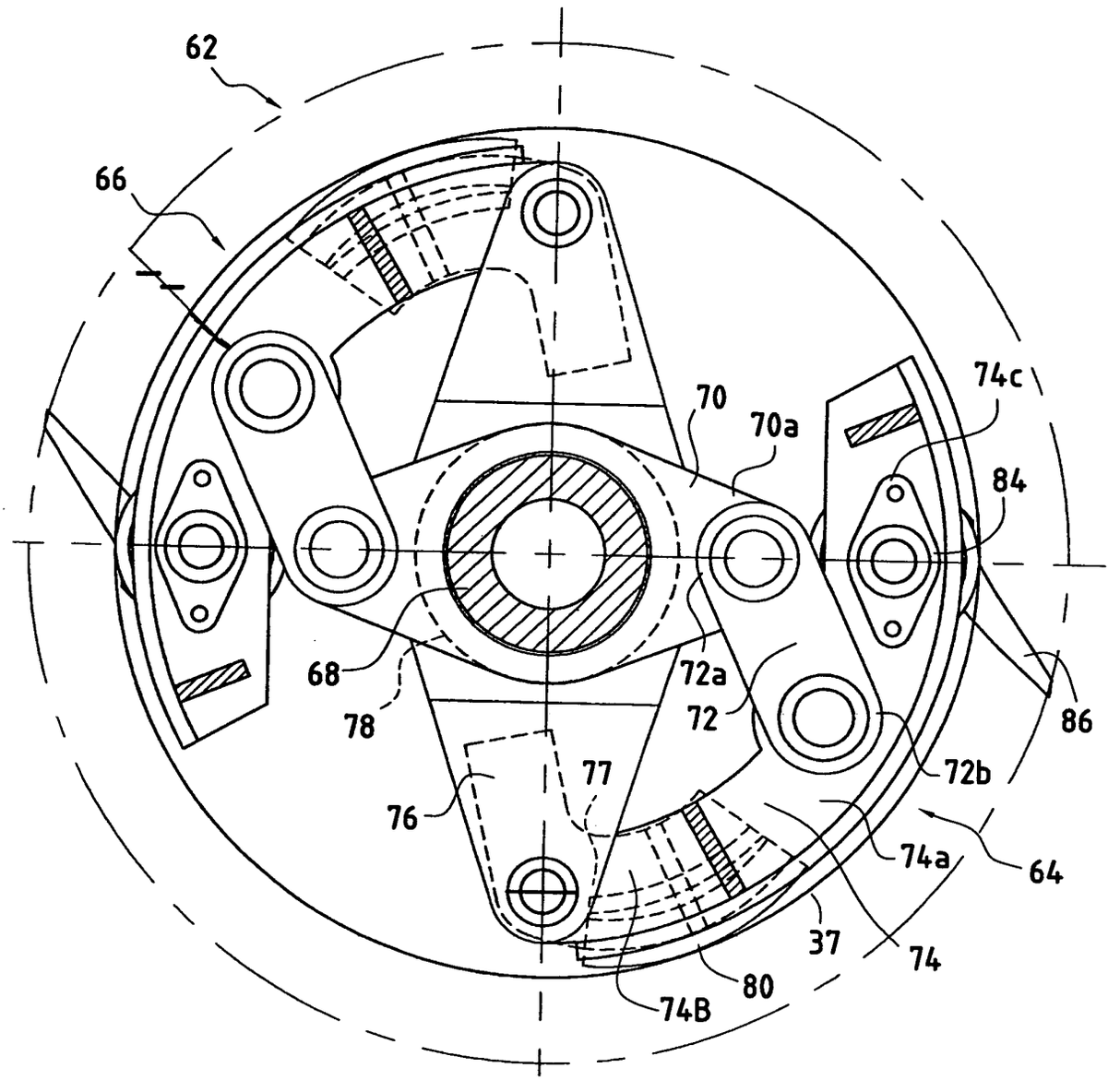

FIG.4A

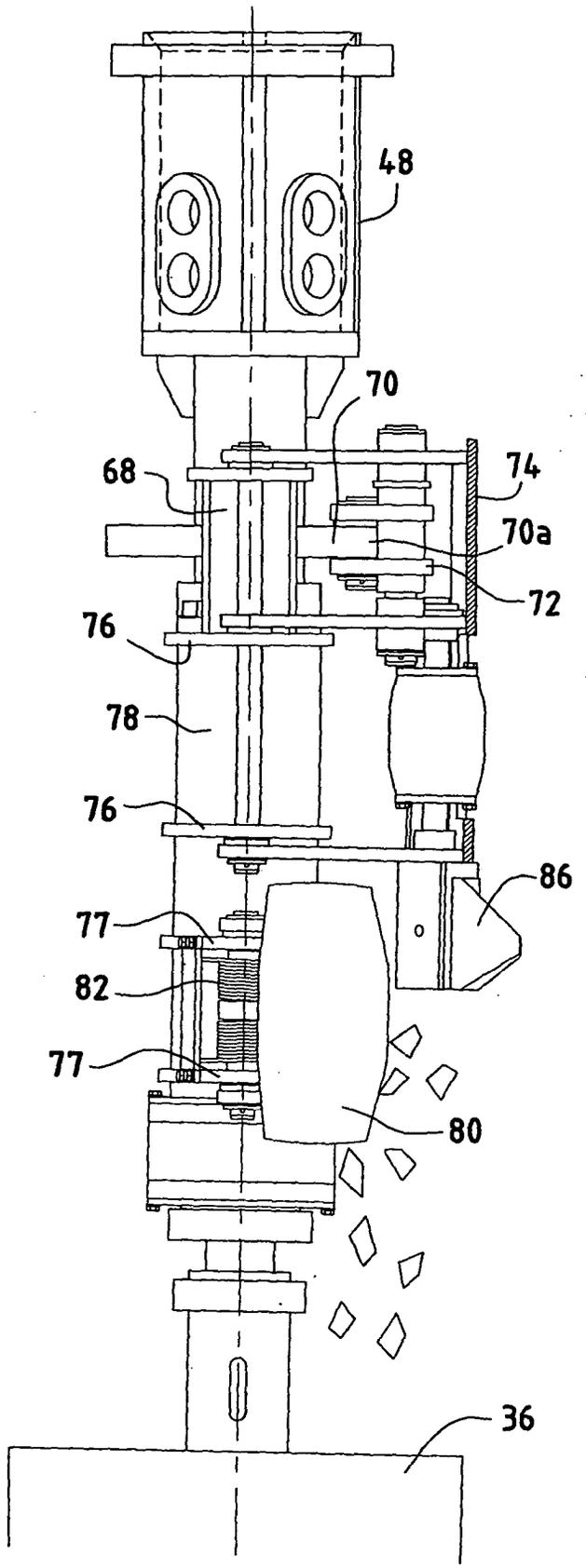

FIG.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 29 1004

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	GB 2 183 703 A (CEMENTATION PILING AND FOUNDATION LIMITED) 10 June 1987 (1987-06-10) * page 1, line 61 - page 2, line 50; figures 1-3,6-9 *	1-3,6,11	E02D5/56
A	US 1 916 691 A (SCHROEDER) 4 July 1933 (1933-07-04) * page 1, line 33 - page 2, line 23; figures 1-7 *	4,5	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E02D
E21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 July 2004	Kergueno, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 29 1004

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-07-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2183703 A	10-06-1987	NONE	
US 1916691 A	04-07-1933	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82