



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.06.2001 Bulletin 2001/24

(51) Int Cl.7: **E02D 5/80**

(21) Application number: **00120833.9**

(22) Date of filing: **25.09.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(74) Representative: **Agostini, Agostino et al**
Dragotti & Associati srl
Via Paris Bordone, 9
31100 Treviso (IT)

Remarks:

A request for correction to Figure 4 has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(30) Priority: **06.12.1999 IT TV990135**

(71) Applicant: **Frare, Gian Pietro**
31100 Treviso (IT)

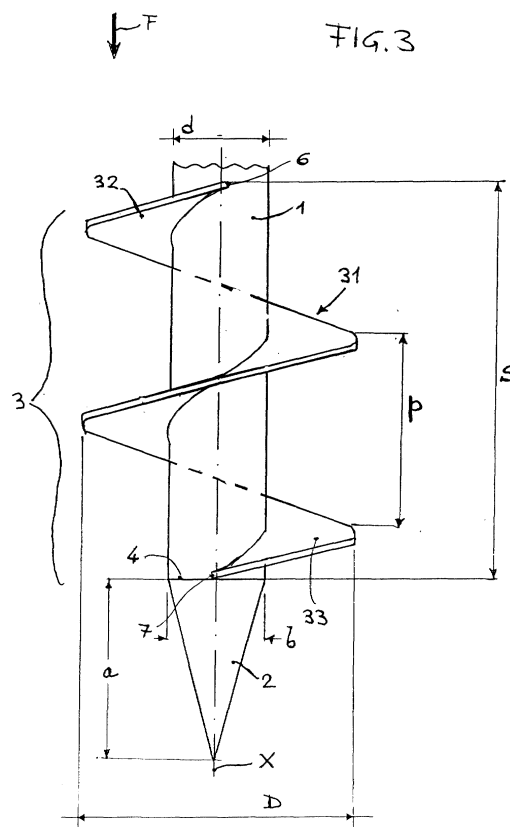
(72) Inventor: **Frare, Gian Pietro**
31100 Treviso (IT)

(54) **Threaded anchorage system for installation in cohesive and non cohesive granulated loose materials**

(57) An anchorage system comprises a cylindrical rod (1), a preferably conical tip (2) and a threaded part or screw (3) coaxial to the rod and welded onto it consisting of a central portion (31) having an uniform outer diameter (D), an upper and a lower tapered portion (32, 33). The central portion (31) is extended for more than one and no more than three turns, preferably two turns, while the upper and lower portions (32, 33) preferably have an angular extension of about 120° (α_1) to 150° (α_1) along the common axis (X) of the rod (1) and the screw (3).

USE: The anchorage system is specifically designed for installation in granulated loose materials, cohesive and non cohesive.

ADVANTAGES: Easy installation. High resistance to extraction. No removal of the drilled material. Negligible environmental impact Simple manufacture and at a low cost



Description

[0001] The invention is referred to an anchorage system specifically designed for the installation in a granulated loose material, both cohesive such as clay and non cohesive, such as top soil or sand.

[0002] Anchorage systems consisting either of poles, having a comparatively bigger diameter, or by rods (pickets), having a smaller diameter, are widely known and diffused and their installation usually makes use of percussive, compressive and vibratory means.

[0003] In particular, an anchorage system is known consisting of so-called screw piles, which is the true background of the invention. On pages 161-163 of his book "Pali e fondazioni su pali" (i. e. "Piles and pile-based groundworks"), 4th edition, Milano, 1993, which is the most complete source available in Italy, Renato Sansoni reports the following information about this anchorage system:

- screw piles entered into use at the end of the 19th century but are at present only utilized in a few marine and harbour groundworks;
- screw piles are characterized by a conical thread (whose angle of aperture is shown to be 53°) having a pitch commonly is 1/3 to 1/6 the pile diameter and a shape adequate to the nature of the soil to be drilled. In case of very soft soil, use is made of a thread of an uniform diameter.
- their installation in the soil needs a rotation accompanied by a pressure.

[0004] From the patent IT-A-1 281 633 a screw pile is furthermore known which is attached to a twisted tip and consists in a cylindrical iron body either hollow, when the diameter is in the range $\frac{3}{4}$ " - 2" (namely about 19 to 51 mm), or solid when the diameter is less than $\frac{3}{4}$ ". A thread, consisting of an iron strap wound as a spiral with the same axis, is welded onto a considerable portion (about 70%) of the length of the cylindrical body and is abruptly interrupted at its ends. The thread, with a high number of turns, all of a constant pitch and an uniform diameter, ends at some distance from the attachment line of the twisted tip.

[0005] A first drawback of the said screw pile seems to be the scarifying action during the installation which causes the drilled material to be raised along the cylindrical body up to the soil surface from where it is dispersed. In this manner the drilled material has a reduced compactness and is scarcely adhered to the pile. As a consequence it is reasonable to assume this screw pile to have a low resistance to extraction as a second drawback. It is in fact foreseen, when the pile body is hollow, to inject a certain amount of mortar through a plurality of apertures provided in the proximity of the tip in order to have the mortar subsequently raising up through the soil around the pile. A hardened mortar will for sure increase the pile resistance to extraction but cannot be

free of a significant environmental impact when the pole is removed from the installation site at a subsequent time.

[0006] It would then be desirable, and actually is a main object of the invention, to provide an anchorage system, specifically designed for the installation in a granulated loose material, cohesive and non cohesive, which is free of the drawbacks now affecting the known screw piles. Another object of the invention is to provide an anchorage system which can be mass produced with simple means and at a relatively low manufacturing cost

[0007] An anchorage system with the features claimed here below attains the mentioned objects, as it will be clarified by the following non limiting description of a preferred embodiment illustrated in the attached drawing where:

- Figure 1 shows a first version of the present invention;
- Figure 2 shows a second version;
- Figure 3 shows in a bigger scale a front view of the threaded part, which for simplicity will be here below referred as screw, which characterizes the invention;
- Figure 4 shows the said screw as seen in the direction of arrow F of Figure 3.

[0008] As one can see in Figure 1, an anchorage system according to the invention, which is specifically designed for the installation in a granulated loose material T, either cohesive or not cohesive, comprises the following parts, made with iron having an anticorrosive treatment : a cylindrical solid rod 1 (whose diameter is designated by $\underline{d}$ in Figures 3 and 4), a conical tip 2 (whose length and maximum diameter are respectively designated by $\underline{a}$ and $\underline{b}$) attached to rod 1 along a circular attachment line 4 and a screw 3 having the same axis X as the rod 1 and a length $\underline{s}$ which is welded to the rod 1. This anchorage system can be classified at the same time as a "strut-pile", when subject to axial compressive stress or as a "tie rod", when subject to tensile stress. It is commonly utilized as a strut-pile when the diameter $\underline{d}$ of the rod 1 is as big as about 75-80 mm and as a tie rod when diameter $\underline{d}$ is about 10-20 mm.

[0009] In the tip 2, for an optimum drilling efficiency, the ratio $\underline{a/b}$ is inversely proportional to the diameter $\underline{d}$ of the rod 1, more precisely $\underline{a/b}$ is down to about 2 in case of piles and up to about 3 in case of pickets.

[0010] The main features of the invention are listed and clarified here below.

- The screw 3 consists of a central portion 31, an upper and a lower tapered portion 32 respectively 33. As it is clearly shown in Figure 1, the length $\underline{s}$ of the screw 3, namely the distance between its end points 6 and 7, is remarkably shorter than the length $\underline{L}$ of the rod 1, namely the distance between the line 4 of attachment of tip 2 and the opposed end 5 of the

rod. Preferably, $\underline{s} \leq 0,3 \underline{L}$.

- The central portion 31 of screw 3 is extended for no more than three turns, preferably for two turns, as illustrated in the attached Figures. As a matter of fact, the extensive tests made by the Applicant confirmed that one turn only provides an insufficient anchorage in the drilled material while three or more than three turns are redundant, namely so scarcely improved over two turns that the corresponding higher manufacturing cost is not justified.
- In the said central portion 31 the screw 3 has an uniform diameter, designated by $\underline{D}$ namely the width $\underline{a_c} = (\underline{D} - \underline{d})/2$ of its wing - see Figure 4 - has a constant value selected within the range $0,3\underline{d} \leq \underline{a_c} \leq 5\underline{d}$, more precisely a lower value in case of piles (where diameter $\underline{d}$ is bigger) and a higher value in case of pickets (where $\underline{d}$ is smaller).
- Also the pitch $\underline{p}$ of the screw 3 in its central portion 31 is constant with a value selected in the range $0,7\underline{d} \leq \underline{p} \leq \underline{d}$, more precisely a lower value in case of piles than in case of pickets.
- The upper tapered portion 32 of the screw 3 ends at a point 6 which, for the above mentioned reason, is remarkably remote from the end 5 of rod 1 which is opposite to tip 2. In its turn the lower tapered portion 33 of the screw 3 ends at a point 7 which is either positioned onto or very close to the attachment line 4 of tip 2 - see Figures 3 and 4.
- By tapered portions 32, 33 of the screw 3 it is meant that their width is continuously decreasing from the above referred value $\underline{a_c}$ of the width of the central portion 31 to zero at the end points 6 respectively 7. The angular extension of the tapered portions 32, 33 along the axis X, common to rod 1 and to screw 3, is preferably in the range 120° to 150° - see Figure 4, where, for sake of clarity, the periphery of the said portions corresponding to the preferred minimum extension (indicated as α_1) is a short dashed line while the one corresponding to the preferred maximum extension (indicated as α_2) is a continuous line.

[0011] Along its entire length, the cross-section of the screw 3 (i. e. the section formed by a plane perpendicular to axis X) is of a trapezoidal shape, namely the screw 3 is thicker at the welding line to rod 1 rather than at the periphery.

[0012] The variant of the invention illustrated in Figure 2 has the following additional features. A hollow body 10 in the form of a cylindrical or prismatic cup, also extended along the axis X, is welded at its base 11 to the end 5 of rod 1 which is opposite to tip 2. The lateral surface of body 10 is provided with a couple of aligned apertures 13, 14 for the insertion of a transversal arm 8 which, when manually actuated as shown by arrows A, causes the present anchorage system to drill a granulated loose material like a conventional screw pile. In order to drill the granulated loose material, in particular

in case of a rod 1 of a big diameter, it is also possible to attach the hollow body 10 to a motor-driven mandrel (not shown). The hollow body 10 also permits the insertion of the bottom end of an extension pile in order to increase the anchorage depth and the fixation of other parts like a pier, an earth pole etc., as schematically indicated by reference 9.

[0013] From the previous description the advantages of the invention will easily be understood to be:

- (a) a high resistance to tensile as well as to compressive stresses, due to the fact that the drilled material T remains in contact with the rod 1, in particular between the upper end point 6 of screw 3 and the point 5 opposite to tip 2 which are remarkably distant from one another, as already mentioned here above. This high resistance also depends on the compression, transversally to axis X, of the drilled material by the rod 1;
- (b) also the resistance to extraction is quite high, provided that the drilled material T is not raised up to the free surface G, from where it might be removed or swept away.
- (c) no reinforcement with cement mortar injected *in situ* is consequently needed, consequently the environmental impact is negligible;
- (d) thanks to conical shape of the tip 2 and to the very closely positioned lower tapered portion 33, the drilling operation takes place smoothly;
- (e) if the anchorage system is to be taken out of the installation site, it suffices to turn it in the opposite direction as the one shown by arrows A in figure 2. The anchorage system is therefore ready for reuse. It is also to remark that even in this circumstance there will practically be no removal of drilled material.

[0014] The possibility of reproducing the present anchorage system with simple means and at a reasonably low cost will furthermore be appreciated.

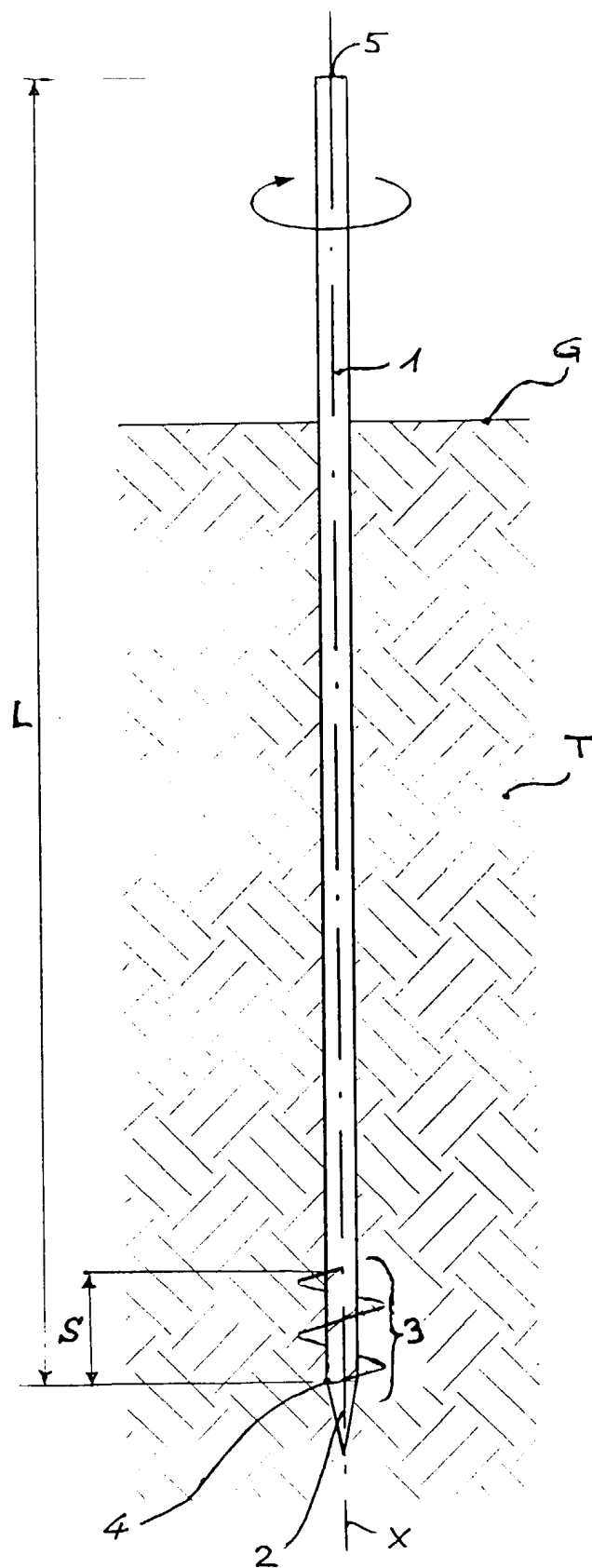
Claims

1. Anchorage system for the installation in a granulated loose material (T), either cohesive or non cohesive, comprising a rod (1) of a preferably round cross-section, a tip (2) attached to the rod (1) along a line (4) and a threaded part or screw (3) having the same axis (X) as the rod (1) and welded to it, characterized in that the screw (3) consists in a central portion (31), which has an extension of more than one turn and no more than three turns and has an uniform outer diameter ($\underline{D}$), therefore a constant width ($\underline{a_c}$), in an upper and a lower portion (32, 33), which are tapered, namely of a width is continuously decreasing from the width ($\underline{a_c}$) of the central portion (31) at the attachment sections to the same up to

zero at their respective end points (6, 7) and in that the distance (s) between the said end points (6,7) along the axis (X) of the rod (1) is remarkably less than the length (L) of the rod (1), preferably $(s) \leq 0,3 (L)$.

2. Anchorage system according to claim 1, characterized in that the central portion (31) of the screw (3) has an extension of about two turns and in that each of the said upper and lower tapered portion (32, 33) has an angular extension of about $120^\circ (\alpha_1)$ to $150^\circ (\alpha_2)$ along the axis (X) of the rod (1). 10
3. Anchorage system according to claim 1 or 2, characterized in that the said width (a_c) of the central portion (31) of the screw (3), which is defined by the formula $(a_c) = [(D) - (d)] : 2$, where (d) is the outer diameter of the rod (1), has a value in the range of about 0,3 to 5 times the diameter (d) of the rod (1), this value being lower in case of a bigger diameter and higher in case of a smaller diameter. 15 20
4. Anchorage system according to any of the preceding claims, characterized in that the said central portion (31) of the screw (3) has a constant pitch (p) of a value selected in the range of 0,7 to 1 times the outer diameter (d) of the rod (1), this value being lower in case of a bigger diameter and higher in case of a smaller diameter. 25 30
5. Anchorage system according to any of the preceding claims, characterized in that the said upper tapered portion (32) of the screw (3) ends at a point (6) remote from the end (5) of the rod (1) which is opposite to the tip (2). 35
6. Anchorage system according to any of the preceding claims, characterized in that the said lower tapered portion (33) of the screw (3) ends at a point (7) which is either onto or in close proximity to the attachment line (4) of the tip (2) to the rod (1).. 40
7. Anchorage system according to any of the preceding claims, characterized in that the cross-section of the screw (3) is of a trapezoidal shape along its length. 45
8. Anchorage system according to any of the preceding claims, characterized in that the base (11) of a hollow body (10), having the form of a cylindrical or prismatic cup, is attached to the end (5) of the rod (1) which is opposite to the tip (2), the said body (10) being adapted for coupling with a hand tool (8) or with a motor-driven mandrel during the installation and the removal of the anchorage system and also adapted for the fixation to another structural part (9). 50 55

9. Anchorage system according to any of the preceding claims, characterized in that the said tip (2) is of a conical shape where the ratio of its length (a) to the diameter (b) of its attachment line (4) to the rod (1) has a value of about 2 to 3, this value being lower in case of a rod (1) with a bigger diameter (d) of the rod (1) and higher in case of a smaller diameter.



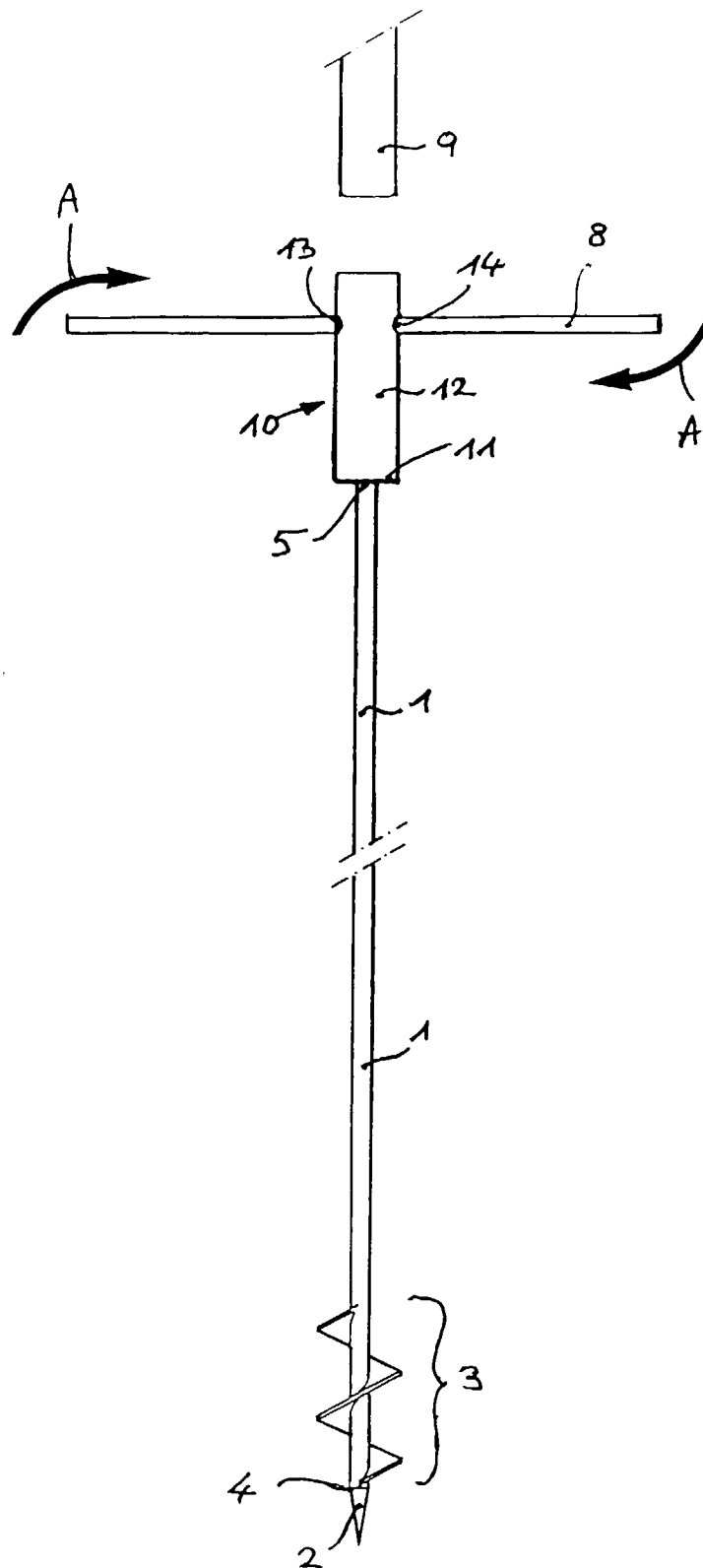
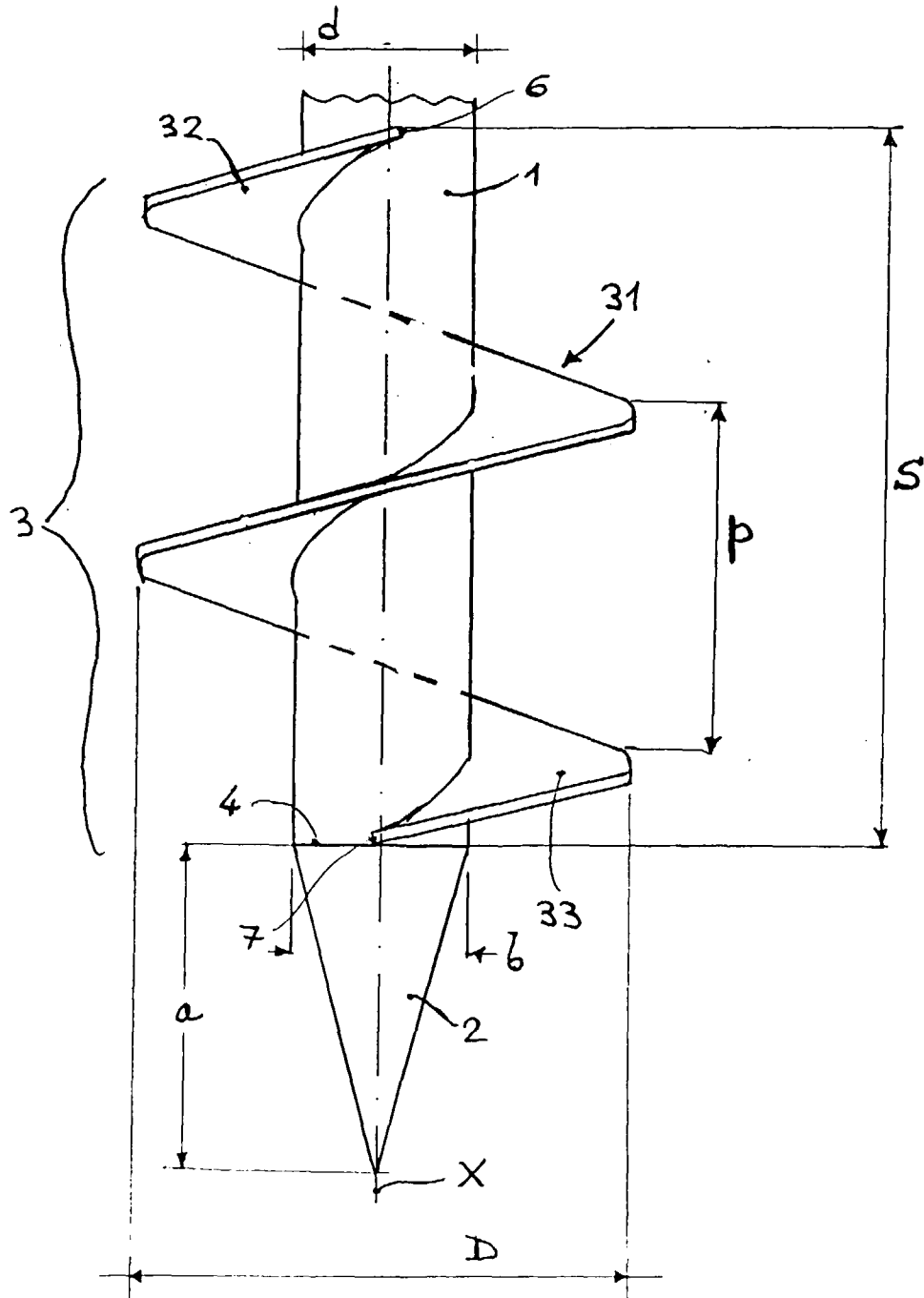


FIG. 2



FIG. 3



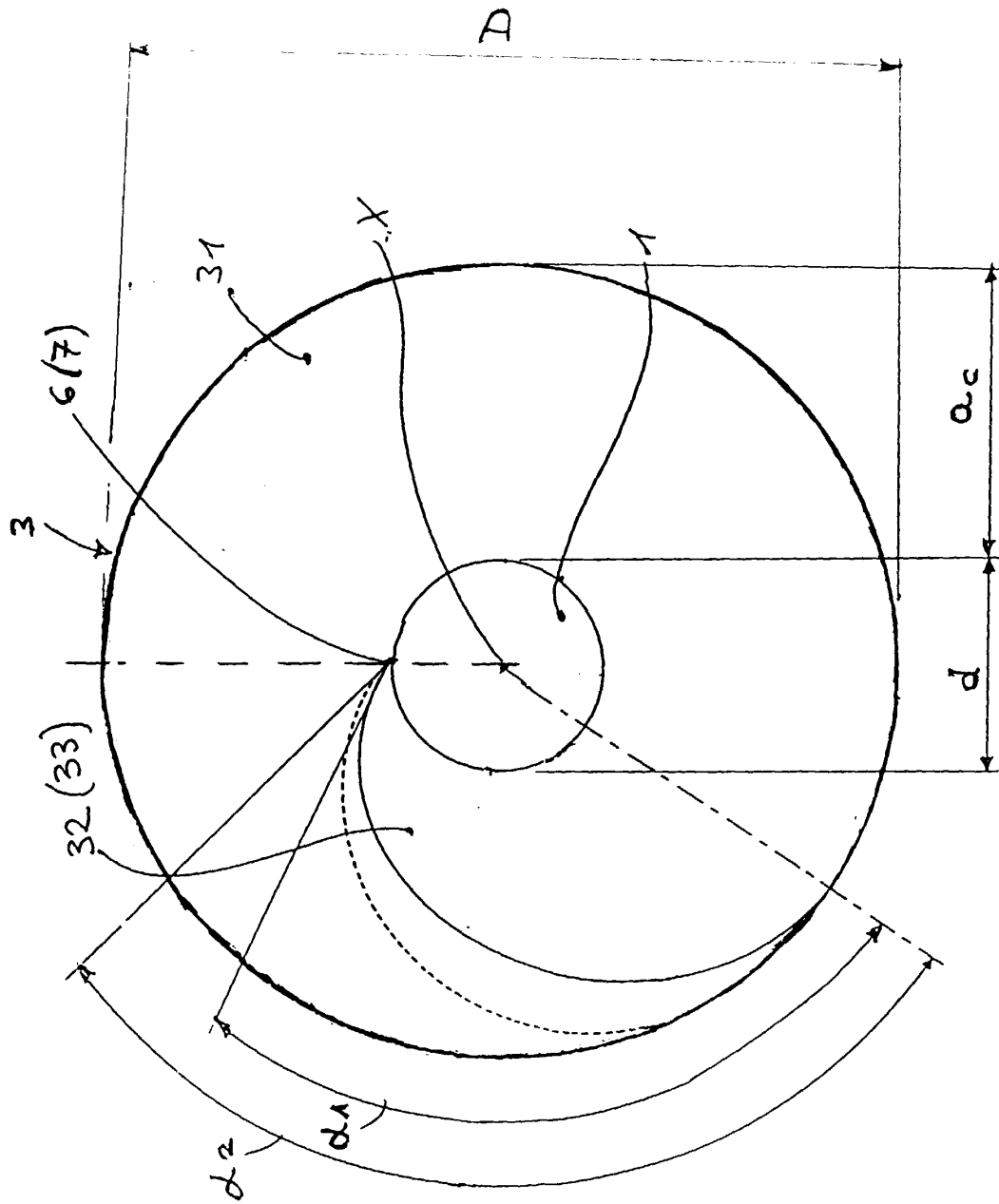


FIG. 4