

"Soil displacement auger head for installing
piles in the soil"

5 This invention relates to a soil displacement auger head for installing piles in the soil, comprising a tip, a displacement body having at least over a lower portion a core diameter increasing in a direction away from said tip, and at least one screw flange extending at least over said lower portion of the displacement body.

10 Such a soil displacement auger head is known from German patent No. 4 220 976. This known auger head has between the lower portion of the displacement body, being conical, and the tip a relatively long cylindrical portion. On this cylindrical portion there is provided a screw flange with a constant pitch and a constant
15 outer diameter. To increase the axial penetrating force during screwing, there was proposed in the embodiment according to Figure 1 of this German patent to extend the screw flange until over the conical portion of the displacement body.

20 Another soil displacement auger head is known from European patent No. 0 228 138. In this known auger head the screw flange is however situated exclusively on the cylindrical portion between the displacement body and the tip and obviously doesn't extend over the
25 displacement body itself.

The invention described hereafter has as object to present an auger head by which the soil can be displaced more efficiently and requiring furthermore less energy during screwing in, and which allows also to screw
30 through more resistant, in particular more sandy, layers.

indeed it has been found surprisingly that, by
5 providing such an increasing pitch, lower torques are
required to screw the auger head into the soil.

Concerning a variable pitch of the screw flange,
reference can be made to DE-PS-576 831. In the auger
head known therefrom the pitch of the screw flange,
10 however, decreases over the displacement body.

In a particular embodiment of the auger head
according to the invention the core diameter of the
lower portion of the displacement body increases
discontinuously according to said screw flange via a
15 predetermined number of transition slopes.

Such a discontinuous diameter increase of the
displacement body is already known per se from US-A-4
458 765. This known auger head has however no clear
screw flange, and certainly no screw flange increasing
20 the pitch of which increases.

According to the present invention, the
discontinuous diameter increase now has been found, in
combination with the increase of the pitch of the screw
flange, to contribute particularly to the reduction of
25 the energy required for making the hole in the soil,
manifested especially during screwing in through
resistant, non-cohesive layers.

Preferably, the pitch of said screw flange
increases in between two successive discontinuous
30 diameter transitions, each time in such a way that,
during screwing in, substantially a same volume of soil
is squeezed and transported before each transition slope
of the displacement body. This can be illustrated for
example on the basis of the relation shown in claim 4.

35 Said transition slopes form for example an angle
comprised between 20 and 40 degrees, and in particular

5 about 30 degrees was found the most suitable.

A further reduction of the required moments for screwing in through resistant layers can be obtained by arranging the slopes on the lower portion of the displacement body under a predetermined angle with respect to the longitudinal direction of the auger head as indicated in claims 8 and 9.

Further particularities and advantages of this soil displacement auger head will become apparent from the following description of some particular embodiments of the auger head according to this invention. This description is only given as an example and is clearly not intended to limit the scope of the invention. The used reference numbers refer to the annexed figures, wherein :

20 Figure 1 shows schematically a side view of an equipment for installing piles in the soil by means of an auger head according to the invention;

Figure 2 shows schematically the different steps for installing a pile in the soil by means of the equipment according to Figure 1;

Figure 3 shows a side view of a soil displacement auger head according to the invention;

Figures 4 and 5 show respectively on a larger scale a cross section according to lines IV-IV and V-V in Figure 3;

Figure 6 shows a side view of a soil displacement auger head according to a variant embodiment of Figure 3;

Figure 7 and 8 show respectively on a larger scale a cross section according to lines VII-VII and VIII-VIII in Figure 6 ;

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5 Figure 10 shows the increase of the pitch of the screw flange of the auger head according to Figure 3 in function of a number of variables.

 In these different Figures the same reference numbers relate to the same or analog elements.

10 In Figure 1 a screwing piling equipment is schematically shown for installing concrete piles in situ in the soil by means of a soil displacement auger head 1 according to the invention.

15 This screwing piling equipment comprises a crane 2 with a vertical mast 3 provided with an auger motor 4. The auger motor 4 is preferably mounted at the bottom of the mast 3 so that said mast can be constructed as light as possible. Of course use can also be made of an auger motor 4 which is movable up and down the mast 3.

20 The different steps for installing a concrete pile in the soil are schematically shown in Figure 2. In a first step the auger head 1 is screwed through the intermediary of an up and downwards movable platform 5 and an auger casing 6 in the soil, so that the soil is
25 displaced laterally. Possibly a downward force down can further be exerted onto platform 5 by means of traction ropes 7. Then a reinforcement 8 is put in through the auger tube 6 and concrete is injected by means of a pump 9 through the auger casing 6 and the auger head 1 in the
30 formed soil cavity 10, while the latter elements are removed out of this hole 10 by means of the hook 11. At this step, the same rotation direction is maintained as during screwing in. The tip 12 of the auger head 1 remains at the bottom in the soil. If desired the
35 reinforcement 8 may be pushed afterwards in the freshly installed pile 13.

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Also one has to screw sufficiently far into the bearing
5 layer in order to assure enough bearing capacity for
pile 13. Most of the soil displacement auger heads
existing at present do not allow to screw through such
harder layers or require thereto excessively large
penetrating forces. As will become apparent
10 hereinafter, this invention describes however, a soil
displacement auger head which can be screwed with a more
efficient displacement under a reduced penetrating force
even through more resistant layers.

In general the auger head 1 according to the
15 invention comprises a tip 12, a displacement body 14
having at least over a lower portion 15 a core diameter
increasing in a direction away from said tip and a screw
flange 16 extending at least over the lower portion 15
of the displacement body 14. To obtain an axial
20 penetration force which is as large as possible during
the screwing in, the screw flange 16 has preferably, at
least over the lower portion 15 of the displacement body
14, a substantially constant outer diameter. This auger
flange 16 delimits a mainly spiral strip with an
25 increasing core diameter on the displacement body 14.

To achieve the objectives mentioned hereinabove,
the invention provides first of all that the screw
flange 16 has, over the lower portion 15 of the
displacement body 15, a pitch 1 increasing in the
30 direction away from the tip 12. The increase of this
pitch will be described hereafter further into detail.

In the represented auger head 1 the displacement
efficiency is still further increased because, as
provided according to a further aspect of the invention,
35 the core diameter of the lower portion 15 of the
displacement body 14 increases over said spiral strip

in resistant, more sandy layers. The result is that
5 smaller forces and/or torques are to be exerted onto the
auger head to screw this through such layers, and this
notwithstanding the fact that the slopes 17 give at
first sight additional resistance.

In an efficient embodiment the discontinuous
10 transition slopes 17 form an angle α comprised between
20 and 40 degrees and preferably between 25 and 35
degrees. The angle α is formed by the tangent plane to
the surface of the displacement body 14 after the
respective slope 17. In the embodiment according to
15 Figures 3 and 4 the angle α comprises about 30 degrees
which appeared particularly efficient for screwing
through compacted sand layers. In this embodiment four
discontinuous transition slopes 17 are provided,
regularly divided over the lower portion 15 of the
20 displacement body 14, more particularly each time turned
over an angle of 450 degrees. In general, this angle is
preferably larger than 360 degrees. At the slopes 17
the core diameter increases with at least 2 cm,
preferably with 3 cm to 15 cm and in particular with 4
25 cm to 10 cm. The number of slopes 17 will depend from
the difference between the minimum d_0 and the maximum
diameter d_m of the displacement body 14.

Between two successive slopes 17 the surface of the
auger head 1 may be somewhat conical, but this surface
30 between two successive slopes 17 is preferably
cylindrical. Preferably the displacement body 14
extends further substantially upto said tip 12, although
an additional portion with a screw flange or not can
further be provided between this displacement body 14
35 and the tip 12.

the tip 12. The pitch 1 of the screw flange 16
5 increases each time between two successive diameter
transitions, particularly in such a manner that, during
screwing in, substantially the same volume of soil is
squeezed and transported before each transition slope
17. The radial displacement of the soil is achieved
10 then mainly at the place of the last discontinuous
transition slope 17, in other words before the maximum
diameter d_m is reached. Indeed, since the pitch
increases each time between two slopes 17, the distance
between the top of the slopes 17 and the outer diameter
15 of the screw flange 16 does become smaller, but the
successive transition slopes 17 have a larger width, so
that the displaced soil is divided at these slopes
mainly over a wider area. This is in particular not the
case for the first slope 17 unless an increase of the
20 pitch is also provided before this slope ; for example
placed on a small additional cylindrical part between
the displacement body 14 and the tip 12 of the auger
head 1. Of course, a certain radial displacement occurs
at each slope.

25 The increase of the pitch of the screw flange 16
may, on the contrary, be continuous. However,
preference is given to a discontinuous increase of the
pitch as in the shown embodiments. In the embodiment
according to Figure 3, the increase of the pitch is
30 achieved each time at about one rotation after each
slope 17, as indicated by means of arrows 18, except of
course for the last slope 17. In this way the strip
between the different windings of the screw flange 16
starts to diverge thus each time after each slope 17.

35 In a preferred embodiment, the increase of the
pitch 1, over the lower portion 15 of the displacement

$$\text{with } \beta_i = \frac{n(d_m^2 - d_o^2)}{n(d_m^2 - d_i^2)}$$

wherein l_o is the pitch at the first slope;

l_i is the pitch at the $i + 1^{\text{st}}$ slope;

10 n is the rotational speed at which the auger head is to be turned;

v is the vertical penetration speed of the auger head in the intended soil ;

d_m is the maximum core diameter of the displacement body;

15 d_o is the minimum core diameter of the displacement body; and

d_i is the core diameter before the $i + 1^{\text{st}}$ slope.

When designing an auger head on the basis of this equation the minimum d_o and the maximum diameter d_m of
 20 the displacement body are first of all determined as function of the pile diameter to be achieved. Further, the number of slopes necessary for this diameter increase is also determined. Then the pitch l_o at the first slope is determined and also the rotational speed
 25 n , all in function of the desired vertical penetration speed. Of course the power of the auger engine 4 will have to be taken into account because a larger pitch l_o and a higher rotational speed require a higher power. On the basis of the pitch l_o and the rotational speed n ,
 30 the theoretical vertical penetration speed can be determined. The real penetration speed v will be at the most equal to this theoretical value and can be determined more exactly on the basis of experimental data. Since the auger head according to this invention
 35 is especially provided to drill through resistant sand layers, the optimal penetration speed v is

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possibly an additional downward force can be applied onto the auger head.

5 On the basis of this equation the relation between the pitch increases β_1 , β_2 , β_3 for the three last slopes of the embodiment according to Figure 3 and the real penetration speed v is given in Figure 10 and this for a rotational speed of 6 and 30 rpm and for a minimum diameter d_0 of 21 cm and a maximum diameter d_m of 46 cm.

10 As it appears from Figures 3 and 6, the slopes 17 on the lower portion 15 of the displacement body 14 are preferably directed downwards each under a predetermined angle γ with respect to the longitudinal direction of the auger head 1. This predetermined angle γ further decreases as the respective slope is further removed from tip 12. Due to such an orientation of the discontinuous transition slopes 17 the required penetration force can be reduced further.

15 In a specific embodiment, the transition slope 17 which is the closest to the tip 12 forms an angle γ of 0 to 20 degrees and preferably of 5 to 10 degrees with the longitudinal direction of the auger head 1 while the slope which is the farthest removed from the tip 12 forms an angle of 0 to 5 degrees with this longitudinal direction. The possible transition slopes 17 situated between the first and the last slope form then an angle of an intermediate value.

20 On the front of tip 12 of the auger head 1, teeth 19 may further be provided for grinding the soil. The embodiment according to Figure 3 comprises two teeth 19, one of which being fixed onto the screw flange 16 and the other on an additional screw flange part 20, which terminates already before the first slope 17. The tip 12 itself is, in the usual way, removably mounted onto the auger head 1 in such a manner that it remains in the

auger in such a way that it can be recuperated, for
5 example hingedly between an open and a closed position.

In order to displace again laterally any possible
soil situated on top of the auger head, during screwing
the auger head 1 out, the displacement body 14 has in
the embodiment according to Figure 3 an upper portion 21
10 with a core diameter decreasing in the direction away
from said tip. This upper portion comprises further
four screw flange parts 22', 22'', 22''' and 22'''', each
extending over about 225 degrees and overlapping each
other over about 45 degrees, as it appears from Figure
15 5. Since the screw flange parts 22 have a screw
direction opposite to the screw direction of the screw
flange 16, these screw flange parts 22 will provide
that, during screwing the auger head out, the soil
situated on top of this auger head, will be displaced
20 once again by the upper portion 21 of the displacement
body 14. During screwing in itself, the division in
screw flange parts 22 permits that any possible soil
which nevertheless would penetrate till above the
displacement body 14, can escape between these screw
25 flange parts 22 so that no stop is formed which could
hamper the operation of the auger head.

Preferably, the upper portion 21 of the
displacement body 14 has also a core diameter decreasing
discontinuously via a predetermined number of transition
30 slopes 23. Contrary to the transition slopes 17 on the
lower portion 15 these transition slopes 23 are in
particular directed upwardly under a predetermined angle
 γ with respect to the longitudinal direction of the
auger head 1, more particularly under an angle γ of 0 to
35 30 degrees and preferably under an angle of 10 to 15
degrees.

5 are disposed according to a screw direction opposite to
the screw direction of the screw flange 16 and extend in
particular over about one turn around the auger head 1.
The use of mutually overlapping fins 24 offers also in
10 this embodiment the advantage that upon screwing in soil
can escape between these used fins 24 reducing once more
the penetration energy.

For displacing the soil radially when screwing the
auger head 1 out, an inclined displacement surface 25 is
arranged underneath each of the fins 24. Starting from
15 the displacement surface 25 which is situated underneath
the fins 24 and which is the farthest removed from the
tip 12, each of these displacement surfaces 25 project
further radially. In this way the displacement surface
25, which is situated underneath the fin 24, which is
20 the closest to the tip 12, extends to about the maximum
diameter d_m of the displacement body 14. In this way
the soil is also displaced to a further extent radially
by each of the successive displacement surfaces 25. As
it appears from Figures 5 and 6 these displacement
25 surfaces 25 are preferably curved.

In the embodiment according to Figure 9, an
additional part 26 with at least one lateral opening 27
of a concrete duct 28 extending through the auger head
1 is provided between the displacement body 14 and the
30 tip 12 of the auger head 1. Before this lateral opening
27 the auger head 1 has preferably an increasing core
diameter which decreases discontinuously at the opening
27. In this way the soil is displaced laterally before
the opening during screwing in so that at the opening 27
35 a space arises in the soil which can be filled up via
this opening 27 with pressurized concrete. During

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squeezed soil and together the mixture is laterally displaced in the surrounding soil, as the displacement body continues its downward movement so that a reinforced contact wall pile-soil is obtained.

From the previous description it will be clear that the invention is not limited to the embodiments described herein before, but that all kinds of detailed modifications could be applied thereto, for example concerning the shape and the arrangement of the different components of the auger head, without leaving the scope of this invention.

The outer diameter of the screw flange 16 could possibly be larger than the maximum core diameter d_m of the lower portion of the displacement body 14. In this case the upper portion 21 of the displacement body 14 has, in particular in the embodiment according to Figure 6, then preferably also a maximum core diameter which is substantially equal to the outer diameter of the screw flange 16. In this way, a larger part of the soil can penetrate between the fins 24 during screwing in, till above the auger head 1, whereby less energy is required during screwing in. When screwing out, which clearly requires obviously less energy, this soil can be displaced further radially.

5 lower portion (15) a core diameter increasing in a
direction away from said tip (12), and at least one
screw flange (16) extending at least over said lower
portion (15) of the displacement body (14),
characterised in that said screw flange (16) has a pitch
10 which increases at least over said lower portion (15) of
the displacement body (14) in the direction away from
said tip (12).

2. Auger head according to claim 1,
characterised in that the core diameter of the lower
15 portion (15) of the displacement body (14) increases
discontinuously according to said screw flange (16) via
a predetermined number of transition slopes (17).

3. Auger head according to claim 2,
characterised in that the pitch of said screw flange
20 (16) increases in between two successive diameter
transitions, each time in such a way that, during
screwing in, substantially a same volume of soil is
squeezed and transported before each transition slope
(17) of the displacement body (14).

25 4. Auger head according to claim 2 or 3,
characterised in that the increase of said pitch is
defined on the basis of the following relation :

$$l_i = l_0 \cdot \frac{n(d_m^2 - d_0^2) - v(d_i^2 - d_0^2)}{n(d_m^2 - d_i^2)}$$

30 wherein :

l_0 is the pitch at the first transition slope (17);

l_i is the pitch at the $i + 1^{\text{st}}$ transition slope (17);

n is the rotational speed at which the auger head

35 (1) is to be turned;

5 d_0 is the minimum core diameter of the displacement
body (14); and
 d_i is the core diameter before the $i + 1^{\text{st}}$ transition
slope.

10 5. Auger head according to any one of the
claims 2 to 4, characterised in that said transition
slopes (17) form an angle α comprised between 20 and 40
degrees, preferably between 25 and 35 degrees and in
particular an angle α of about 30 degrees with a tangent
plane to the surface of the displacement body after the
15 respective transition slope (17).

 6. Auger head according to any one of the
claims 2 to 5, characterised in that at said transition
slopes (17) the core diameter of the displacement body
(14) increases with at least 2 cm, preferably with 3 cm
20 to 15 cm and in particular with 4 cm to 10 cm.

 7. Auger head according to any one of the
claims 2 to 6, characterised in that the displacement
body (14) has a substantially cylindrical surface
between two successive transition slopes (17).

25 8. Auger head according to any one of the
claims 2 to 7, characterised in that said transition
slopes (17) on the lower portion (15) of the
displacement body (14) are directed downwards each under
a predetermined angle γ with respect to the longitudinal
direction of the auger head (1), said predetermined
30 angle γ being smaller as the core diameter before the
concerned transition slope (17) is larger.

 9. Auger head according to claim 8,
characterised in that the transition slope (17) which is
35 the closest to said tip forms an angle γ of 0 to 20
degrees and preferably of 5 to 10 degrees with the

claims 1 to 9, characterised in that said screw flange (16) has a substantially constant outer diameter at least over the lower portion (15) of the displacement body (14).

10 11. Auger head according to any one of the claims 1 to 10, characterised in that said displacement body (14) has over an upper portion (21) a core diameter which decreases in the direction away from said tip (12), this upper portion comprising at least two screw
15 flange parts (22) each extending over at least half of the circumference of the displacement body (14), at the most over the perimeter of this displacement body (14), and overlapping each other partially and having a screw direction opposite to the screw direction of the screw
20 flange (16) on the lower portion (15) of the displacement body (14).

12. Auger head according to claim 11, characterised in that said screw flange parts (22) extend over 200 to 250 degrees of the circumference of
25 the displacement body (14), in particular over about 225 degrees of this circumference, and overlap each other over 35 to 55 degrees of this circumference, in particular over about 45 degrees.

13. Auger head according to claim 11 or 12,
30 characterised in that said upper portion (21) of the displacement body (14) has a core diameter which decreases discontinuously via a predetermined number of transition slopes (23).

14. Auger head according to any one of the
35 claims 1 to 10, characterised in that said displacement body (14) has an upper portion (21) comprising a series

5 about one turn around the circumference of the
displacement body (14), which fins (24) overlap each
other partially, an inclined displacement surface (25)
being arranged underneath each of these fins (24) for
displacing the soil radially.

10 15. Auger head according to claim 14,
characterised in that from the displacement surface (25)
which is situated underneath the fin (24), which is the
farthest removed from the tip (12), each of said
displacement surfaces (25) extend further radially, so
15 that the displacement surface (25), which is situated
underneath the fin (24) which is situated the closest to
the tip 12, extends substantially up to the maximum core
diameter of the displacement body (14).

20 16. Auger head according to any one of the
claims 1 to 15, characterised in that between said tip
(12) and the displacement body (14) the auger head (1)
has from this tip (12) an increasing core diameter which
then decreases discontinuously, an opening (27) of a
concrete duct (28) through the auger head (1),
25 debouching to the outside at this discontinuous
decrease.

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"Soil displacement auger head for installing
piles in the soil"

Soil displacement auger head (1) for installing piles
(13) in the soil, comprising a tip (12), a displacement
body (14) having at least over a lower portion (15) a
core diameter increasing in a direction away from said
5 tip (12), and at least one screw flange (16) extending
at least over said lower portion (15) of the
displacement body (14). To obtain a more efficient
displacement, the pitch of the screw flange increases
and the core diameter of the displacement body (14)
10 increases preferably discontinuously via a number of
transition slopes (17).

Figure 3 shall accompany the publication of the abstract.

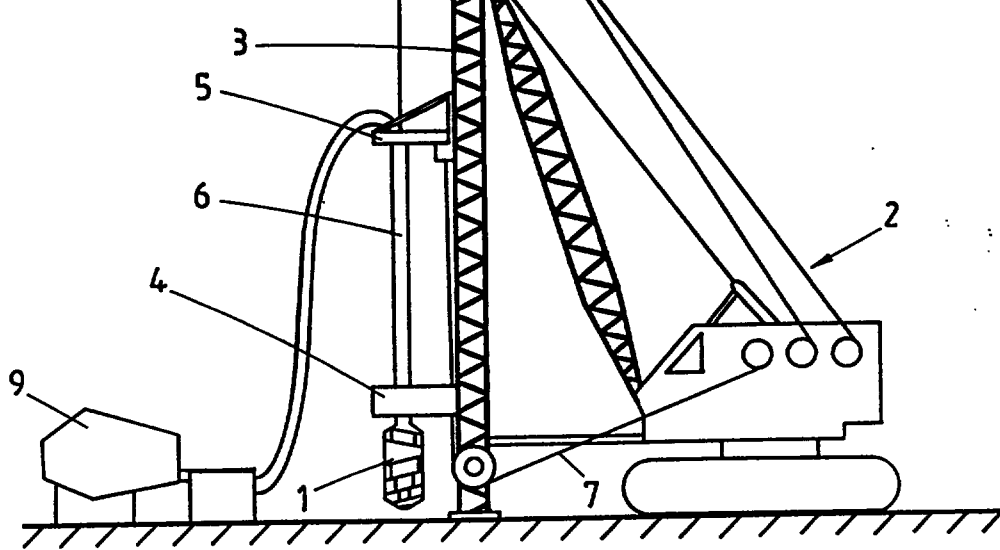


Fig.1

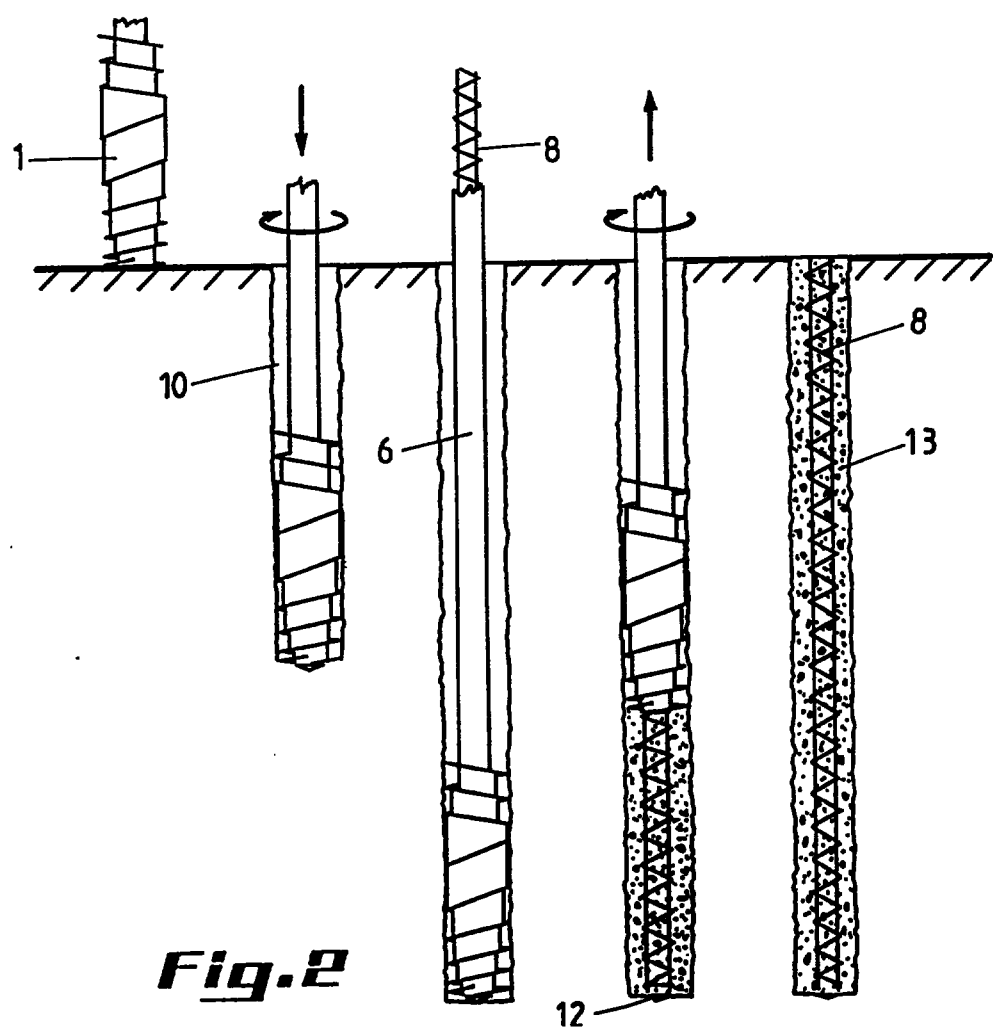
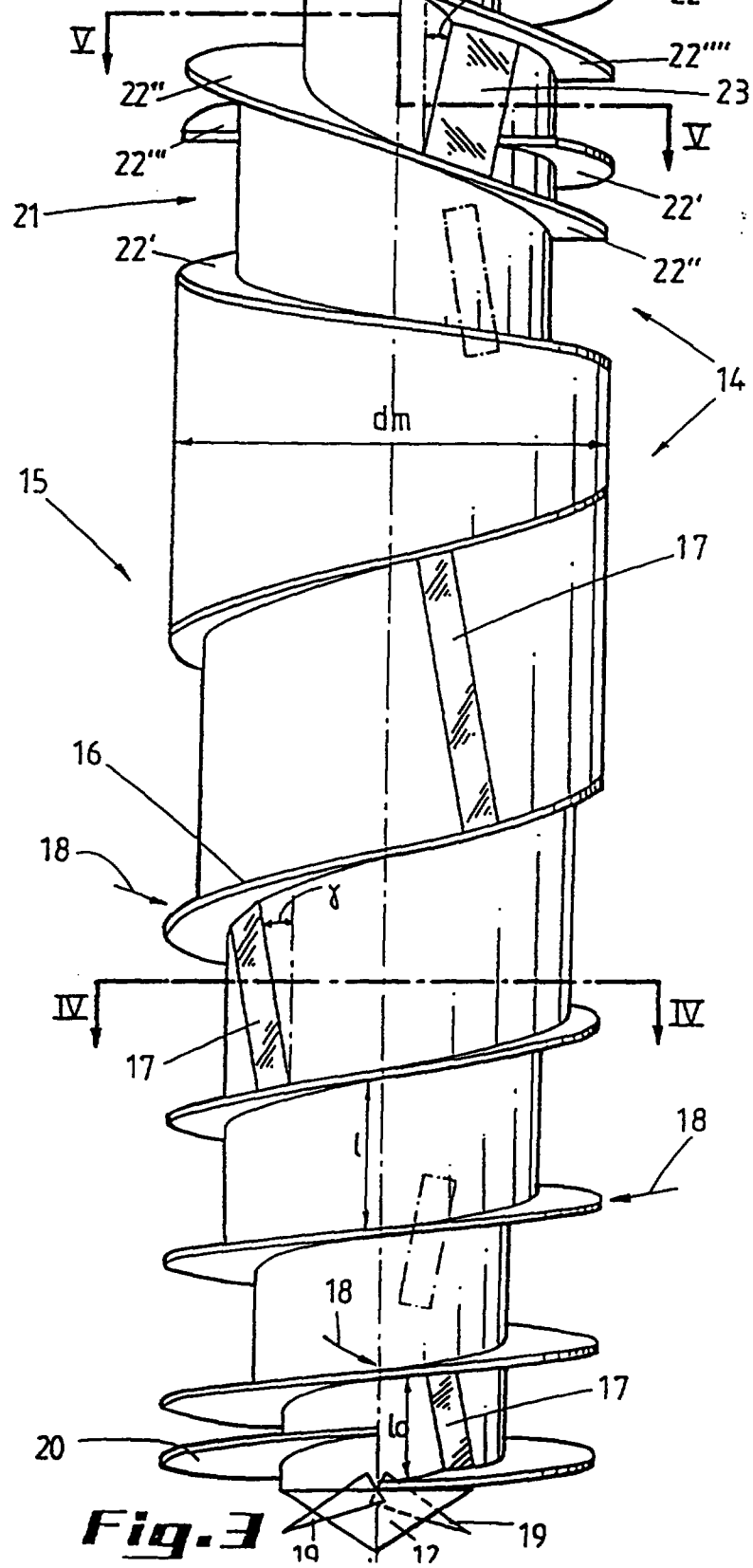


Fig.2



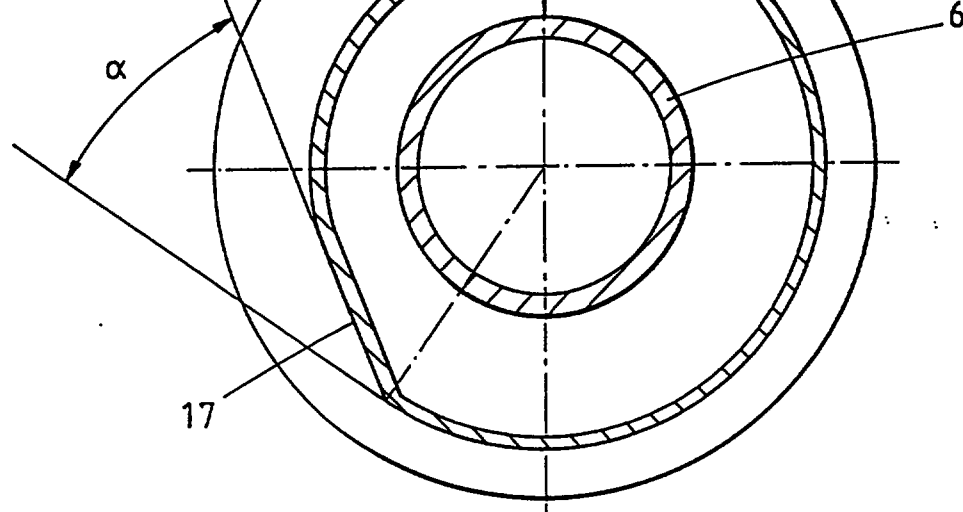


Fig. 4

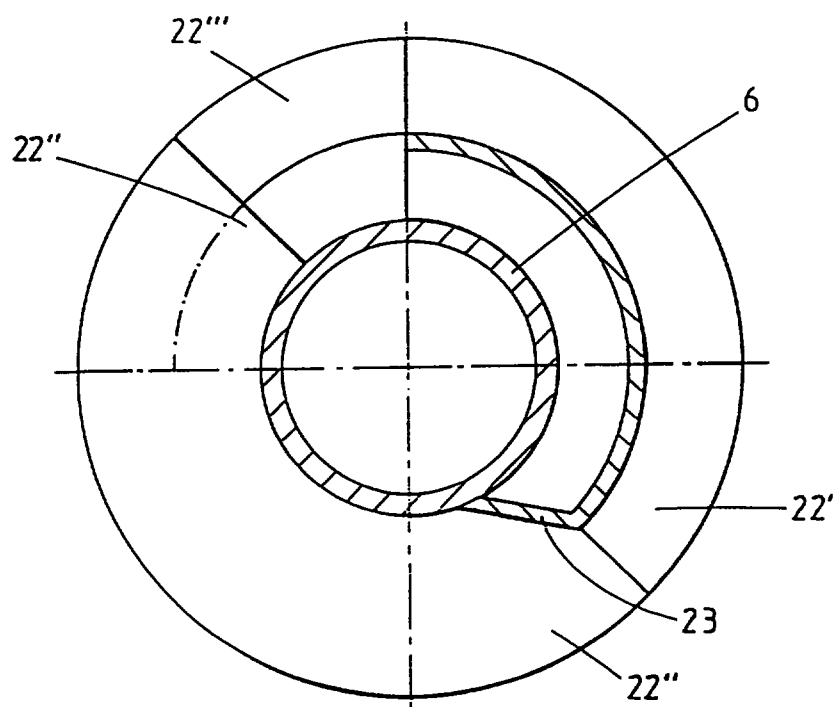
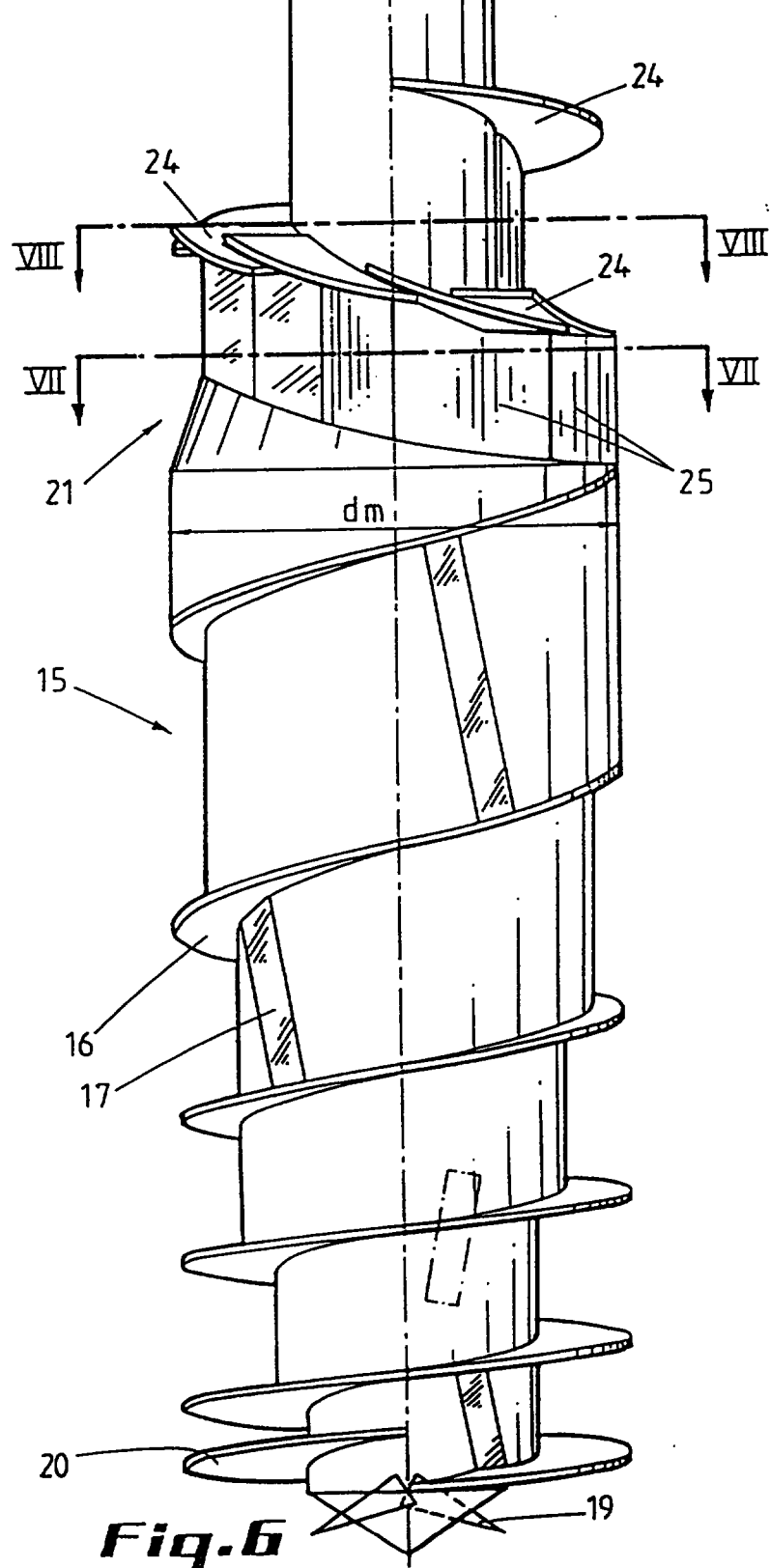


Fig. 5



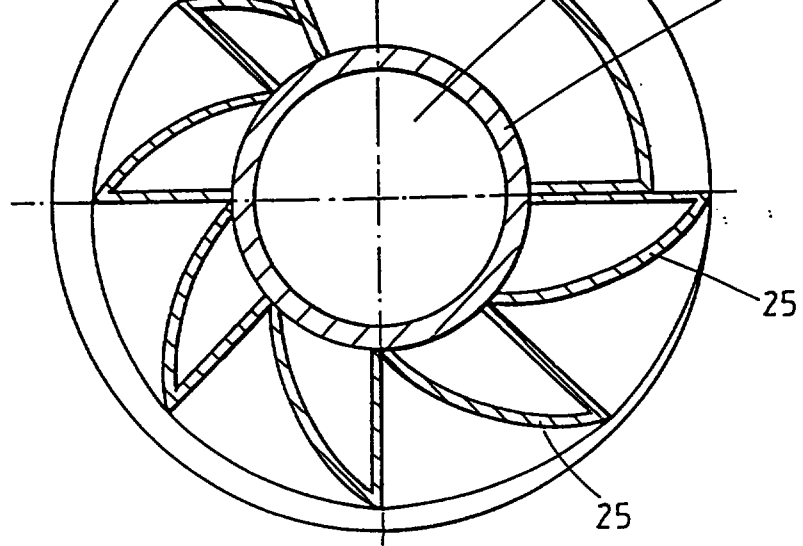


Fig. 7

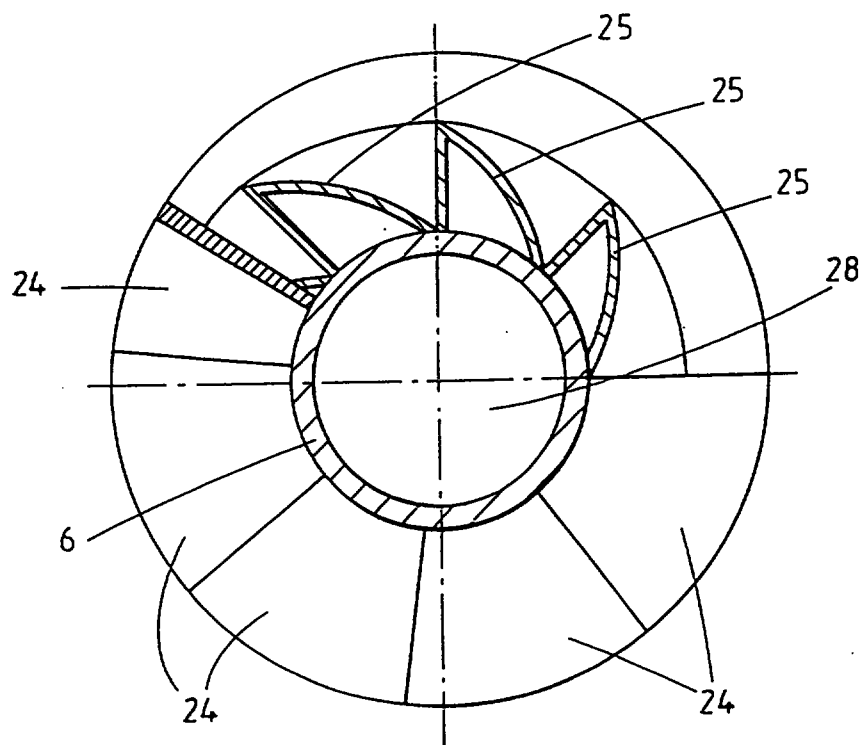


Fig. 8

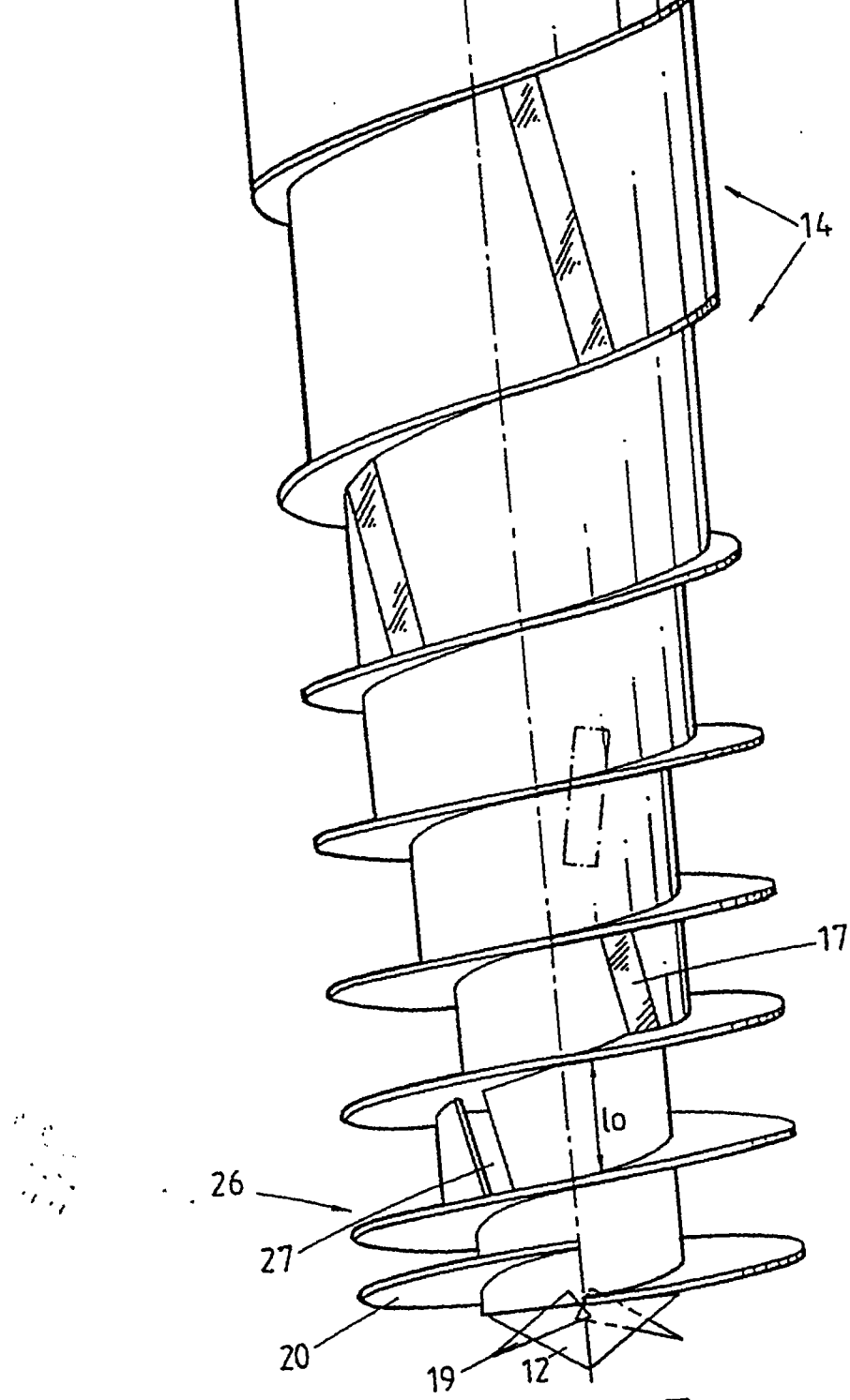


Fig. 9

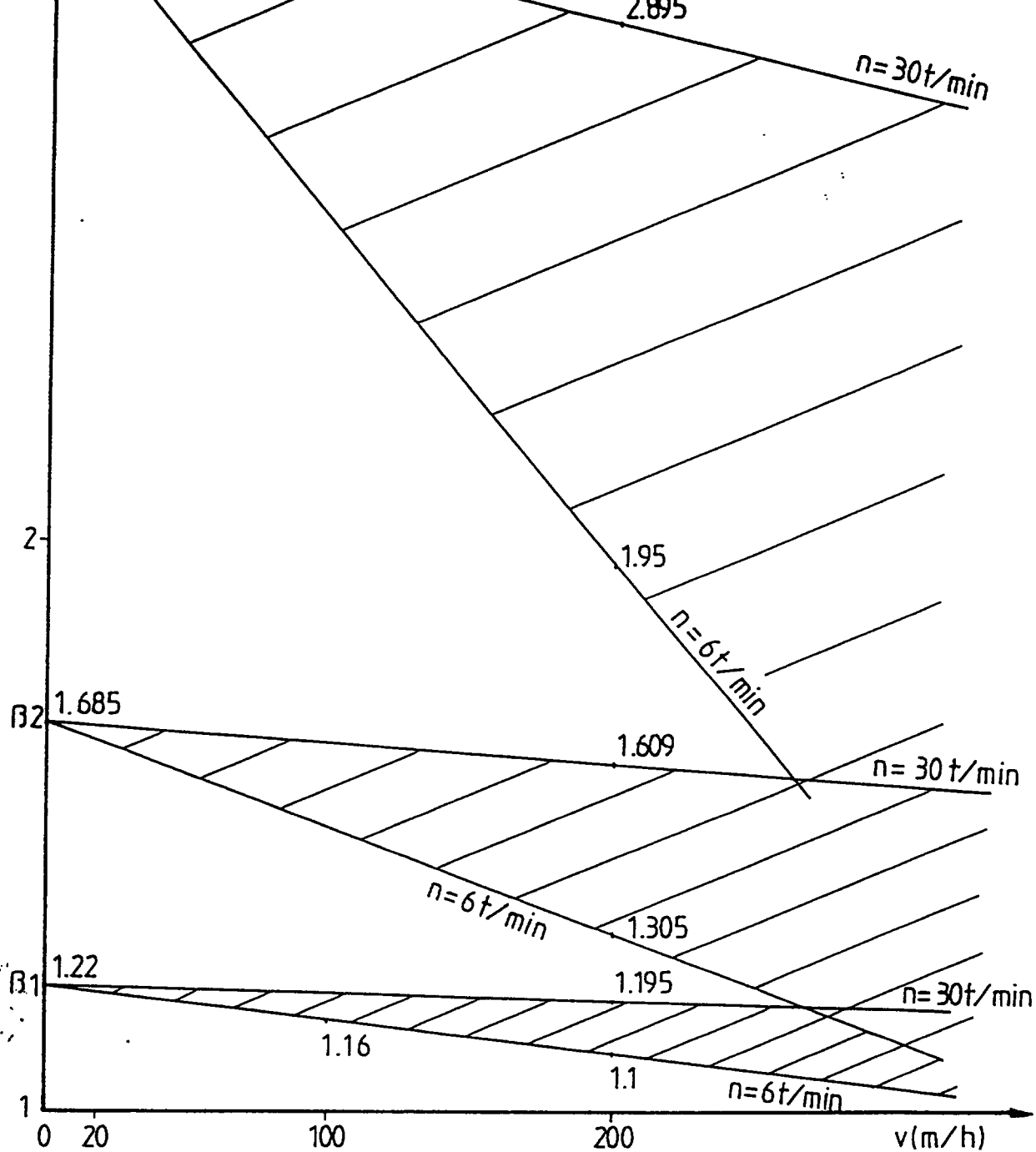


Fig.10

A further reduction of the required moments for screwing in through ~~resistant~~ bearing layers can be obtained by arranging the slopes on the lower portion of the displacement body under a predetermined angle with respect to the longitudinal direction of the auger head as indicated in claims 8 and 9.

Further particularities and advantages of this soil displacement auger head will become apparent from the following description of some particular embodiments of the auger head according to this invention. This description is only given as an example and is clearly not intended to limit the scope of the invention. The used reference numbers refer to the annexed figures, wherein :

Figure 1 shows schematically a side view of an equipment for installing piles in the soil by means of an auger head according to the invention;

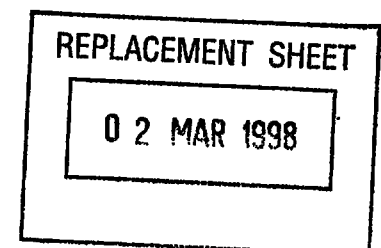
Figure 2 shows schematically the different steps for installing a pile in the soil by means of the equipment according to Figure 1;

Figure 3 shows a side view of a soil displacement auger head according to the invention;

Figures 4 and 5 show respectively on a larger scale a cross section according to lines IV-IV and V-V in Figure 3;

Figure 6 shows a side view of a soil displacement auger head according to a variant embodiment of Figure 3;

Figure 7 and 8 show respectively on a larger scale a cross section according to lines VII-VII and VIII-VIII in Figure 6 ;



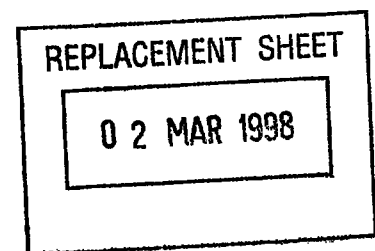
flange of the auger head according to Figure 3 in function of a number of variables.

In these different Figures the same reference numbers relate to the same or analog elements.

10 In Figure 1 a screwing piling equipment is schematically shown for installing concrete piles in situ in the soil by means of a soil displacement auger head 1 according to the invention.

15 This screwing piling equipment comprises a crane 2 with a vertical mast 3 provided with an auger motor 4. The auger motor 4 is preferably mounted at the bottom of the mast 3 so that said mast can be constructed as light as possible. Of course use can also be made of an auger motor 4 which is movable up and down the mast 3.

20 The different steps for installing a concrete pile in the soil are schematically shown in Figure 2. In a first step the auger head 1 is screwed through the intermediary of an up and downwards movable platform 5 and an auger casing 6 in the soil, so that the soil is displaced laterally. Possibly ~~a downward force down~~ an additional push down can further be
25 exerted onto platform 5 by means of traction ropes 7. Then a reinforcement 8 is put in through the auger tube 6 and pressurized concrete is ~~injected~~ poured by means of a pump 9 through the auger casing 6 and the auger head 1 in the ~~formed~~ displaced soil cavity 10, while the latter elements are removed
30 out of this hole 10 by means of the hook 11. At this step, the same rotation direction is maintained as during screwing in. The tip 12 of the auger head 1 remains at the bottom in the soil. If desired the reinforcement 8 may be pushed afterwards
35 in the freshly installed pile 13.



$$\text{with } \beta_i = \frac{n(d_m^2 - d_i^2)}{n(d_m^2 - d_0^2) + v(d_i^2 - d_0^2)}$$

wherein l_0 is the pitch at the first slope;

l_i is the pitch at the $i + 1^{\text{st}}$ slope;

10 n is the rotational speed at which the auger head is to be turned;

v is the vertical penetration speed of the auger head in the intended soil + layer;

d_m is the maximum core diameter of the displacement body;

15 d_0 is the minimum core diameter of the displacement body; and

d_i is the core diameter before the $i + 1^{\text{st}}$ slope.

When designing an auger head on the basis of this equation the minimum d_0 and the maximum diameter d_m of
 20 the displacement body are first of all determined as function of the pile diameter to be achieved. Further, the number of slopes necessary for this diameter increase is also determined. Then the pitch l_0 at the first slope is determined and also the rotational speed
 25 n , all in function of the desired vertical penetration speed. Of course the power of the auger engine 4 will have to be taken into account because a larger pitch l_0 and a higher rotational speed require a higher power. On the basis of the pitch l_0 and the rotational speed n ,
 30 the theoretical vertical penetration speed can be determined. The real penetration speed v will be at the most equal to this theoretical value and can be determined more exactly on the basis of experimental data. Since the auger head according to this invention
 35 is especially provided to drill penetrate through resistant sand layers, the optimal penetration speed v is

REPLACEMENT SHEET

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5 are disposed according to a screw direction opposite to
the screw direction of the screw flange 16 and extend in
particular over about one turn around the auger head 1.
The use of mutually overlapping fins 24 offers also in
10 this embodiment the advantage that upon screwing in soil
can escape between these used fins 24 reducing once more
the penetration energy.

For displacing the soil radially when screwing the
auger head 1 out, an inclined displacement surface 25 is
arranged underneath each of the fins 24. Starting from
15 the displacement surface 25 which is situated underneath
the fins 24 and which is the farthest removed from the
tip 12, each of these displacement surfaces 25 project
further radially. In this way the displacement surface
25, which is situated underneath the fin 24, which is
20 the closest to the tip 12, extends to about the maximum
diameter d_m of the displacement body 14. In this way
the soil is also displaced to a further extent radially
by each of the successive displacement surfaces 25. As
it appears from Figures 5-7 and 6-8 these displacement
25 surfaces 25 are preferably curved.

In the embodiment according to Figure 9, an
additional part 26 with at least one lateral opening 27
of a concrete duct 28 extending through the auger head
1 is provided between the displacement body 14 and the
30 tip 12 of the auger head 1. Before this lateral opening
27 the auger head 1 has preferably an increasing core
diameter which decreases discontinuously at the opening
27. In this way the soil is displaced laterally before
the opening during screwing in so that at the opening 27
35 a space arises in the soil which can be filled up via
this opening 27 with pressurized concrete. During

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5 displacement body (14) and extending preferably over
about one turn around the circumference of the
displacement body (14), which fins (24) overlap each
other partially, an inclined displacement surface (25)
being arranged underneath each of these fins (24) for
displacing the soil radially.

10 15. Auger head according to claim 14,
characterised in that from the displacement surface
(25) which is situated underneath the fin (24), ~~which~~
~~is the farthest removed from the tip (12)~~, each of said
displacement surfaces (25) extend further radially, so
15 that the displacement surface (25), ~~which is situated~~
underneath the fin (24) ~~which is situated~~ and the
closest to the tip 12, extends substantially up to the
maximum core diameter of the displacement body
(14).

20 16. Auger head according to any one of the
claims 1 to 15, characterised in that between said tip
(12) and the displacement body (14) the auger head
(1) has from this tip (12) an increasing core diameter
which then decreases discontinuously, an opening
25 (27) of a concrete duct (28) through the auger head
(1), debouching to the outside at this discontinuous
decrease.

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