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(71) Applicant: **Decombi B.V.**
6604 CW Wijchen (NL)

(72) Inventor: **Bouten, Jacques Anthonius Maria**
6602 ZX, Wijchen (NL)

(74) Representative: **Jilderda, Anne Ayolt**
Octrooibureau LIOC B.V.,
Postbus 13363
3507 LJ Utrecht (NL)

(54) Assembly for forming an elongated construction element under ground, and a displacement element for use therein

(57) An assembly for forming an elongate construction element underground, in particular a foundation pile, comprises an elongate displacement body (10) and a device for driving the displacement body into the ground in an axial direction. The displacement body is provided at an outer end (13) with at least one displacing member (14) and with an outflow opening (12) for a curing construction liquid. The at least one displacing member herein comprises at least one substantially flat blade which extends in axial direction from the outer end of the displacement body. The blade (14) is provided with at least one recess (21..24) within a periphery (15) which may or may not be imaginary.

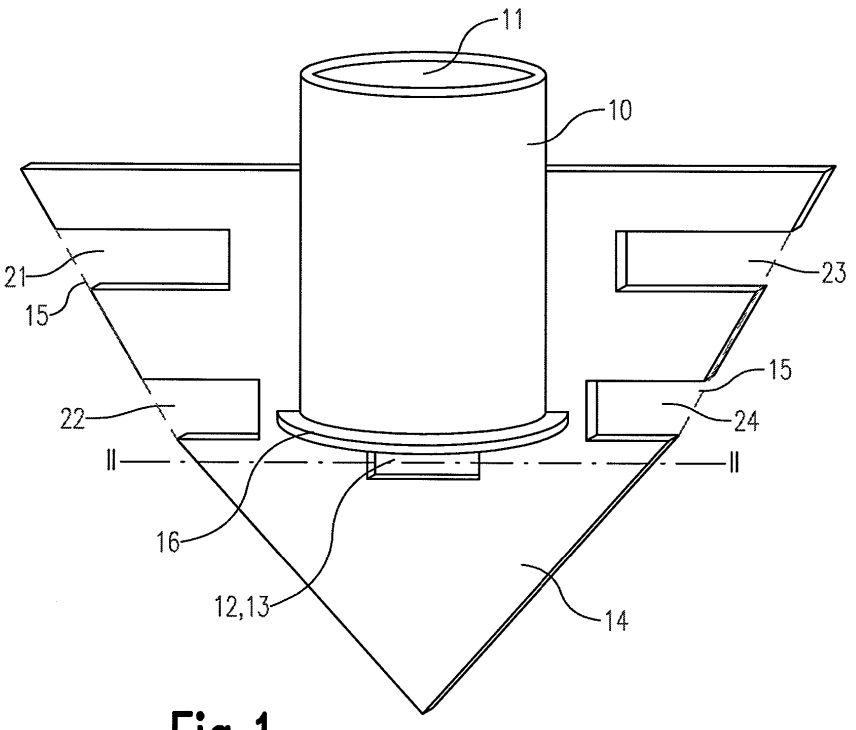

Fig.1

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Description

[0001] The present invention relates to an assembly for forming an elongate construction element underground, in particular a foundation element, comprising an elongate displacement body and a device for driving the displacement body into the ground in an axial direction, wherein the displacement body is provided at an outer end with at least one displacing member and with at least one outflow opening for a curing construction liquid.

[0002] Such an assembly is known from an earlier Netherlands patent granted under number 193.640. In the assembly described therein the displacement element comprises a hollow, steel tube which is provided at an end with a displacing member in the form of a set of propeller blades with an opposing pitch arranged on a periphery of the tubular body. The tube is driven into the ground while already rotating using a device adapted for this purpose, wherein a cement-like construction liquid is introduced via the tube and can escape from the outflow opening at an outer end of the tube. This so-called grout forms a cement covering around an outer wall of the tube and the propeller blades, which mixes with ground material to form a curing mortar. As the tube is inserted into the ground, this layer also fulfills a lubricating function when still in liquid form, so that only a small torque is necessary to drive the tube with the propeller blades further into the ground. Once at or at least close to the desired depth, the tube is usually driven up and down repeatedly so as to thus enable an excess of grout to be relinquished to the ground and to be mixed with the earth to form a weighted lump, which eventually cures to form a solid foundation base. The displacement body finally remains behind in the ground, surrounded by a protective grout casing, and thus forms a construction element which can be applied in particular as a foundation pile.

[0003] In the known assembly the propeller blades, which extend transversely from the tube, provide a considerable resistance in axial direction, this being particularly manifest in the forming of the base, wherein the tube is moved repeatedly up and downward. The propeller blades are therefore provided with cut-away parts in order to reduce this resistance and moreover enable a better mixing of grout with ground material. Nevertheless, the known assembly is then still not found to be practical in use, particularly in respect of forming such a foundation base. This final stage of the process of inserting the known tube is therefore relatively time-consuming.

[0004] The present invention has for its object, among others, to provide an assembly of the type stated in the preamble, whereby this drawback is obviated to at least significant extent.

[0005] In order to achieve the intended object an assembly of the type stated in the preamble has the feature according to the invention that the at least one displacing member comprises at least one substantially flat blade which extends in axial direction from the outer end of the displacement body, and that the blade is provided with at least one recess within a periphery which may or may not be imaginary. Because such a flat blade has only a limited section transversely of the displacement direction, the resistance encountered by the displacing member when the displacement body is driven up and downward is likewise limited, and more particularly considerably lower than that of the propeller blades of the known assembly. The body can hereby be pulled up and pushed down relatively easily while it is being driven into the ground and after the desired depth has been reached. If desired, a weighted base can hereby be formed very rapidly on the displacement element. The recess or recesses in the blade here provide for a sufficient mixing capacity between construction liquid, injected from the outflow opening into the ground, and ground material so that a uniform mortar is created which cures into a solid whole. The invention is suitable here for both pressureless pumping and pumping of the construction liquid under forced pressure.

[0006] Although there is per se a great freedom of choice within the scope of the invention in respect of the shape of the blade, a preferred embodiment of the assembly has the feature according to the invention that at least a lower part of the blade tapers to a point in axial direction. Due to such a pointed form the displacement body allows of easier and more precise placing, and the body will 'find' to a greater extent a linear path downward during insertion.

[0007] The at least one recess can be realized in the blade in various ways. In a first particular embodiment the assembly according to the invention has the feature in this respect that the at least one recess comprises at least one indented part within an imaginary periphery of the blade. When the displacement body is rotated in the ground, the earth is found to be churned up and mixed with the outflowing construction liquid particularly effectively at the position of such an indented part.

[0008] Instead of or in addition thereto, a further particular embodiment of the assembly according to the invention has the feature that the recess comprises at least one opening arranged within the blade. Such an opening reduces rotational friction of the displacement body and provides a further improvement in the mutual mixing of the construction liquid with the ground material.

[0009] For an adequate anchoring of the displacement body in a foundation base which may be formed thereon, a further preferred embodiment of the assembly according to the invention has the feature that, at the outer end of the displacement body, at least one collar part extends transversely thereof. At a relatively modest size such a collar part already provides for an adequate anchoring in the cured foundation base, which keeps the displacement body from sinking into it. In a further particular embodiment the assembly herein has the feature according to the invention that the collar part comprises a flanged edge extending over a full periphery of the outer end.

[0010] The invention also relates to a displacement body of the type as applicable in the above described assembly according to the invention, and will now be further elucidated on the basis of a number of exemplary embodiments and an accompanying drawing. In the drawing:

figure 1 shows a perspective view of a first exemplary embodiment of a displacement body of an assembly according to the invention;
figure 2 shows a cross-section along line II-II in figure 1;
figure 3 shows a perspective view of a second exemplary embodiment of a displacement body of an assembly according to the invention; and
figure 4 shows a cross-section of a third exemplary embodiment of a displacement body of an assembly according to the invention.

[0011] The figures are otherwise purely schematic and not drawn to scale. Some dimensions in particular may be exaggerated to greater or lesser extent for the sake of clarity. Corresponding parts are designated in the figures with the same reference numeral.

[0012] Figure 1 shows a first exemplary embodiment of a displacement body of an assembly according to the invention. The displacement body comprises a steel tube 10 with a diameter in the order of 7-50 centimetres and a length in the order of 5 to 20 metres or even longer, depending on the local depth of a solid ground layer. The tube is hollow, having typically a wall thickness in the order of about 4 to 30 millimetres, and comprises a liquid channel 11 which debouches at an outflow opening 12 in or close to an underside 13 of the tube. In figure 2 the tube is further shown in a cross-section along line II-II in figure 1.

[0013] In addition to the tube, the assembly comprises a mobile crane device with a piling frame (not further shown). During operation the tube 10 is received in the piling frame coupled to the crane and driven into the ground therewith to the desired depth while rotating and pushing an axial direction. On its outer end the tube 10 is provided with a displacing member 14 which according to the invention comprises a substantially flat drill blade extending in axial direction. When tube 10 is rotated in the ground, this blade 14 provides for an effective displacing of ground material to clear the way for displacement body 10.

[0014] While the tube is being driven into the ground, a cement-like construction liquid, so-called grout, is guided into liquid channel 11 from the top and escapes on an underside from outflow opening 12. If desired, the outflow opening can be provided with a controllable valve to enable dosage, or at least control, of the outflow of grout from the tube. The grout flowing from outflow opening 12 of tube 10 mixes around the tube with ground material to form a casing of curing mortar. During the insertion process this mortar, which is then still fluid, also functions as a lubricant which facilitates a further rotation and driving of tube 10 into the ground.

[0015] The drill blade 14 applied in this exemplary embodiment tapers downward to a point to enable the tube to be better positioned and driven straight into the ground. As according to the invention, the drill blade is provided with at least one recess, in this example in the form of four indented parts 21-24 inside an imaginary periphery 15 defined by drill blade 14. Owing to these recesses 21-24 an adequate mixing of ground material with grout is achieved during the insertion of tube 10. While the tube is being driven into the ground, the tube is moved continuously up and downward in order to enhance the outflow of grout. Once at the desired depth, the tube is driven up and downward a number of extra times so as to inject and mix with earth an excess of grout so as to form a weighted base. Owing to the narrow profile of drill blade 14 transversely of the axial direction of the tube, displacement body 10 encounters no additional resistance here, or hardly so, so that such a base can also be formed relatively rapidly and reliably.

[0016] Tube body 10 remains behind in the ground afterward and thus forms for instance a foundation pile or other type of construction element. For an additional anchoring of tube 10 in the curing base, the tube comprises on the outer end a collar part in the form of a continuous flanged edge 16 which extends transversely of tube body 10 and engages in the surrounding foundation base at that location. Once the base has hardened, this flanged edge 16 provides sufficient grip in the foundation base to keep the construction element from subsiding at an authorized vertical load.

[0017] A second exemplary embodiment of a displacement body 10 of an assembly according to the invention is shown in figure 3. In this example the displacement body also comprises a steel tube 10 having on an outer end 13 a displacing member in the form of a substantially flat blade 14 which tapers to something of a point on an underside. Blade 14 is provided with recesses in the form of two openings 31,32 for the purpose of enhancing an adequate mixing with ground material of grout injected via an outflow opening 12.

[0018] Instead of a single drill blade extending on either side of the tube, half drill blades can also be applied as is shown in a cross-section in figure 4. Instead of a continuous flanged edge 16, three separate collar parts 17 provide for an effective anchoring of the construction element in the exemplary embodiment of figure 4.

[0019] Although the invention has been further elucidated with reference to only a few exemplary embodiments, it will be apparent that the invention is by no means limited thereto. On the contrary, many more variations and embodiments are possible within the scope of the invention for the person with ordinary skill in the art.

Claims

1. Assembly for forming an elongate construction element underground, in particular a foundation pile, comprising an elongate displacement body and a device for driving the displacement body into the ground in an axial direction, wherein the displacement body is provided at an outer end with at least one displacing member and with at least one outflow opening for a curing construction liquid, **characterized in that** the at least one displacing member comprises at least one substantially flat blade which extends in axial direction from the outer end of the displacement body, and that the blade is provided with at least one recess within a periphery which may or may not be imaginary.

2. Assembly as claimed in claim 1, **characterized in that** at least a lower part of the blade tapers to a point in axial direction.

3. Assembly as claimed in one or more of the foregoing claims, **characterized in that** the at least one recess comprises at least one indented part within an imaginary periphery of the blade.

4. Assembly as claimed in one or more of the foregoing claims, **characterized in that** the recess comprises at least one opening arranged within the blade.

5. Assembly as claimed in one or more of the foregoing claims, **characterized in that**, at the outer end of the displacement body, at least one collar part extends transversely thereof.

6. Assembly as claimed in claim 4, **characterized in that** the collar part comprises a flanged edge extending over a full periphery of the outer end.

7. Displacement body of the type as applicable in the assembly as claimed in one or more of the foregoing claims.

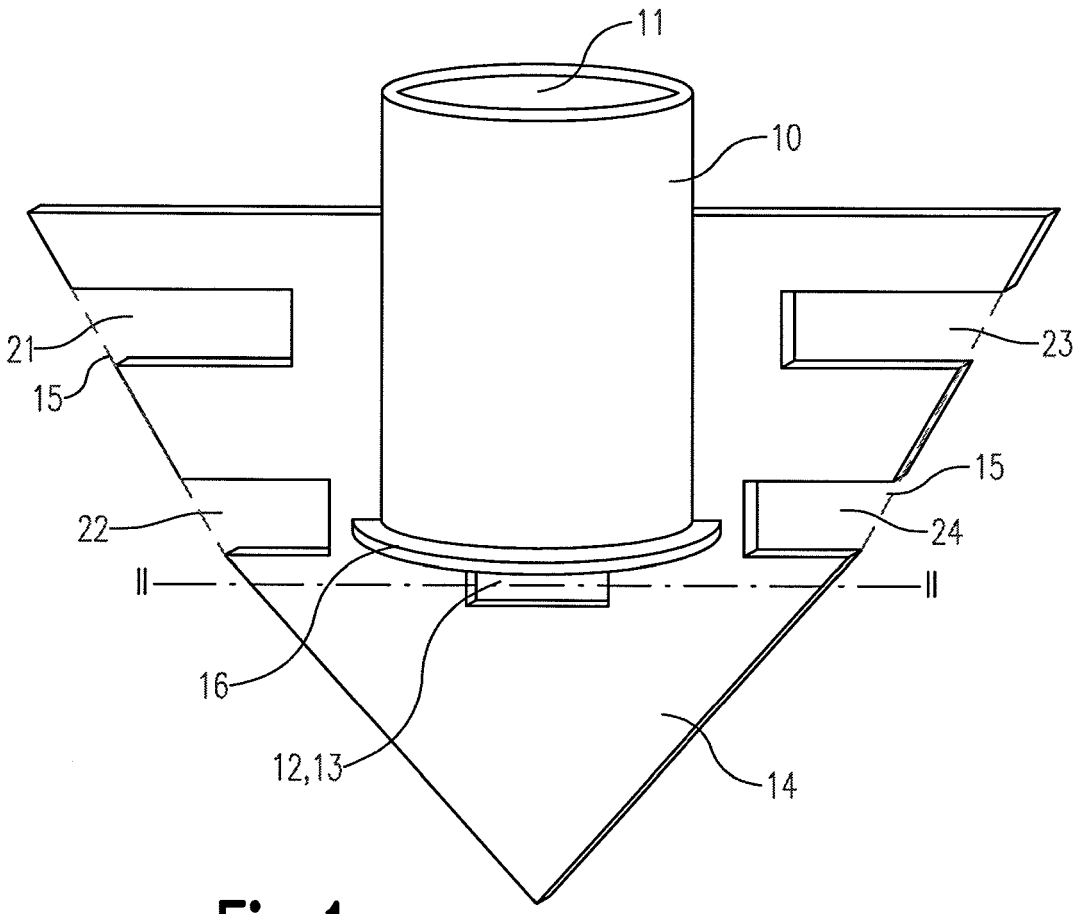

Fig.1

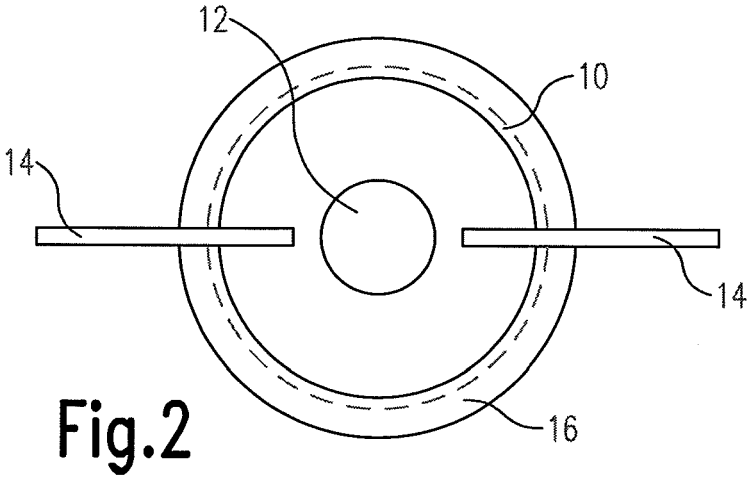

Fig.2

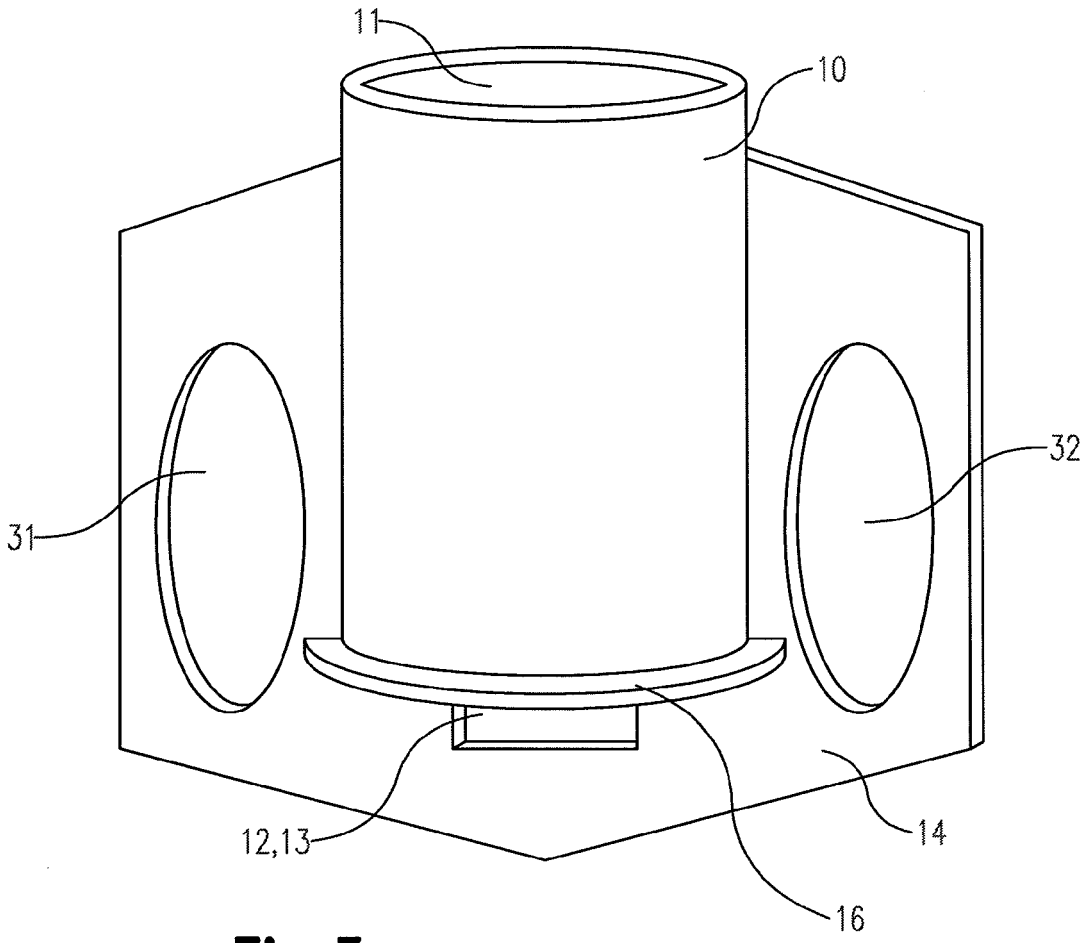

Fig.3

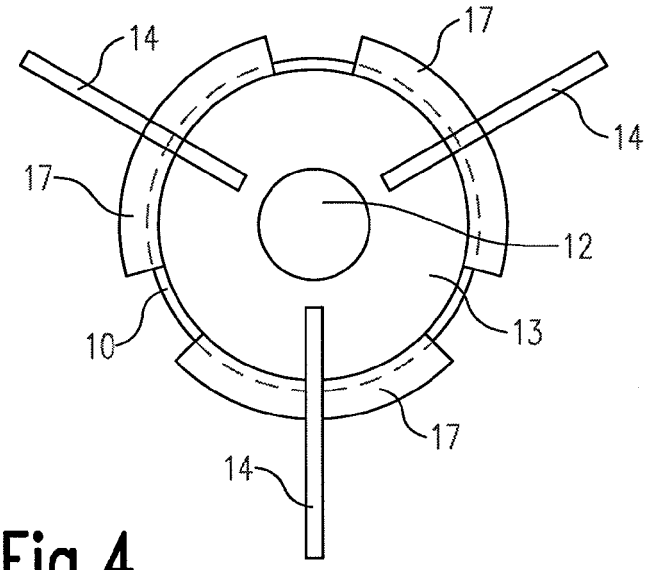

Fig.4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- NL 193640 **[0002]**