AUSTRALIA
Patents Act 1990

634067

P/00/001
Section 29

PATENT REQUEST: STANDARD PATENT

I / We, being the person(s) identified below as the Applicant, request the grant of a patent to the person identified below as the Nominated Person, for an invention described in the accompanying standard complete specification.

Full application details follow.

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[70] Nominated Person PFLEIDERER VERKEHRSTECHNIK GmbH & Co. KG

Address INGOLSTADTER STRASSE 51, 8430 NEUMARKT, Germany

[54] Invention Title "FOUNDATION PILE OF REINFORCED CONCRETE"

[72] Name(s) of actual inventor(s) RICHARD F. FORSTER and FRIEDEMANN A. RUDERSDORF

[74] Address for service in Australia E. F. WELLINGTON & CO., Patent and Trade Mark Attorneys, St. Kilda Road, Melbourne, 3004, Victoria, Australia Attorney Code

ASSOCIATED PROVISIONAL APPLICATION(S) DETAILS

[60] Application Number(s) and Date(s)

BASIC CONVENTION APPLICATION(S) DETAILS

[31] Application Number	[33] Country	Country Code	[32] Date of Application
P 40 20 757.9-25	GERMANY		29th June 1990

DIVISIONAL APPLICATION DETAILS

[62] Original application number

Person by whom made

☐ I am an *opponent / *eligible person described in Sections 33 - 36 of the Act.

To be completed if the ~~complete specification~~ relates to a microorganism.

☐ For the purposes of Section 40, the specification relies on Section 6 of the Act.

For and on behalf of
PFEIDERER VERKEHRSTECHNIK GmbH & Co. KG,

(Signature of Applicant)

7th June 1991
(Date)

BRUCE S. WELLINGTON
Patent Attorney for Applicant Company

*Delete as appropriate

AUSTRALIA

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Notice of Entitlement

We, PFLEIDERER VERKEHRSTECHNIK GMBH & CO. KG, of Ingolstadter Strasse 51, 8430 Neumarkt, Germany, being the Applicant and Nominated person in respect of Application No. 78257/91, state the following:

Convention priority is claimed from the following basic application:

APPLICATION NUMBER	APPLICATION DATE	COUNTRY	COUNTRY CODE
P 4020757.9-25	29 June 1990	Germany	DE

The basic application was filed in our name as assignee of the actual inventors, namely, Richard F. Forster and Friedemann A. Rudersdorf.

The basic application referred to above was the first application made in a Convention country in respect of the invention.

We have entitlement from the actual inventors by assignment, as indicated above.

Our address for service is care of E. F. WELLINGTON & CO., Patent Attorneys, 312 St. Kilda Road, Melbourne, Victoria, 3004.

DATED this 7th day of December 1992

For and on behalf of
PFLEIDERER VERKEHRSTECHNIK
GMBH & CO. KG,
By:-

BRUCE S. WELLINGTON
Patent Attorneys for
Applicant/Nominated Person

To: The Commissioner of Patents,
Commonwealth of Australia

C/KA/7274/8

AU9178257

(12) PATENT ABRIDGMENT (11) Document No. AU-B-78257/91
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 634067

(54) Title
FOUNDATION PILE OF REINFORCED CONCRETE

International Patent Classification(s)
(51)[5] **E02D 005/56** **E02D 005/52** **E02D 005/58**

(21) Application No. : **78257/91** (22) Application Date : **07.06.91**

(30) Priority Data

(31) Number	(32) Date	(33) Country
4020757	29.06.90	DE GERMANY

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RICHARD F. FORSTER; FRIEDEMANN A. RUDERSDORF

(74) Attorney or Agent
E F WELLINGTON & CO , 312 St Kilda Road, MELBOURNE VIC 3004

(57) Claim

1. A reinforced-concrete foundation pile adapted to be rotatably driven into the ground by a pile driving rod, said pile being an elongated cast reinforced-concrete structure having an external ground-drilling spiral or threaded portion and an internal elongated axial passage which is adapted to receive said driving rod and is provided with elongated metal members partially embedded in the elongated cast reinforced-concrete structure along the internal elongated axial passage in diametrically opposed or approximately equiangular distance relationship and substantially parallel with the longitudinal axis of the internal elongated axial passage such that the non-embedded portions protrude freely into the internal elongated axial passage for engagement with the driving rod, the arrangement being such that the elongated metal members can engage with the driving rod upon insertion of the driving rod into the internal elongated passage, whereby the application of torque to the driving rod causes the pile to be rotatably driven into the ground.

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REGULATION 3.2

36246/29-hr

Name of Applicant: PFLEIDERER VERKEHRSTECHNIK GmbH & Co. KG

Actual Inventor/s: RICHARD F. FORSTER
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Address for Service: E.F. WELLINGTON & CO.,
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Melbourne, 3004, Victoria.

Invention Title:

"FOUNDATION PILE OF REINFORCED CONCRETE"

Details of Associated Provisional Applications Nos:

The following statement is a full description of this invention including the best method of performing it known to us.

F-4068

The invention relates to a foundation pile, preferably of reinforced prestressed concrete having external screw threads and an interior cavity for engagement by a driver rod for applying torque.

The preparation of such piles involves considerable difficulties based, on the one hand, on the complicated shaping due to the external screw thread, but on the other hand also based on the exacting quality requirements arising chiefly out of the forces that must be withstood as the pile is screwed into the ground. No less problematical is the task of producing such foundation piles suitable for withstanding the necessary torque and doing so at reasonable cost. In general, the interior cavity is provided with a polygonal cross section to be engaged by a driver rod of similar shape. This configuration, however, extremely complicates the preparation of such piles. Less problematical in this regard is the use of a steel plate applied to the head of the pile and having an opening matching the external shape of the driver rod. The use of a steel head plate, however, is extraordinarily expensive. Initially it has to be fastened to the pile, but after the pile has been driven in and is in use the head plate can no longer be used.

Consequently attempts have been made to design foundation piles of the kind described above such that they can be made inexpensively using the well-known centrifugal casting technique, and in a quality which cannot be equaled by the methods of manufacture used heretofore. The important object is to improve the quality of the piles such that the surface quality will be decidedly improved and a high degree of freedom from cracks will be achieved.

Summary of the Invention

In a first aspect, the present invention provides

a reinforced-concrete foundation pile adapted to be rotatably driven into the ground by a pile driving rod, said pile being an elongated cast reinforced-concrete structure having an external ground-drilling spiral or threaded portion and an internal elongated axial passage which is adapted to receive said driving rod and is provided with elongated metal members partially embedded in the elongated cast reinforced-concrete structure along the internal elongated axial passage in diametrically opposed or approximately equiangular distance relationship and substantially parallel with the longitudinal axis of the internal elongated axial passage such that the non-embedded portions protrude freely into the internal elongated axial passage for engagement with the driving rod, the arrangement being such that the elongated metal members can engage with the driving rod upon insertion of the driving rod into the internal elongated passage, whereby the application of torque to the driving rod causes the pile to be rotatably driven into the ground.

In preferred embodiments of the first aspect of the present invention, the pile is characterized in that:

(i) said elongated cast reinforced-concrete structure is a centrifugally cast reinforced-concrete structure or a centrifugally cast pre-stressed reinforced-concrete structure; or

(ii) said elongated metal members comprise flat steel bars partially embedded in the elongated cast reinforced-concrete structure such that they freely protrude into the internal elongated axial passage by a distance approximately equal to half the width of the broadest side dimension of said bars; or

(iii) said elongated cast reinforced-concrete structure has a longitudinal bottom end portion and a longitudinal top end portion, said spiral or threaded portion

being located at said bottom end portion for said bottom end portion to enter the ground first; or

(iv) said elongated metal members are disposed along said bottom end portion; or

(v) said elongated metal members are disposed along said top end portion; or

(vi) said elongated metal members are connected by traverse rings that are spaced apart from each other in the axial direction of the pile and are affixed to the outer edges of said elongated metal members where they are embedded in the cast reinforced-concrete structure; or

(vii) a foot plate means having cutters is connected to said elongated metal members, more preferably said foot plate means comprises a plate which is generally perpendicular to the axis of the pile, said plate having an inner surface and an outer surface, said cutters being on said outer surface, and said elongated metal members being connected to said inner surface, most preferably said foot plate means being fastened by welding to said elongated metal members.

In a second aspect, the present invention provides the combination comprising a reinforced-concrete foundation pile and a pile driving rod for rotatably driving the reinforced-concrete pile into the ground, said pile being an elongated cast reinforced-concrete structure having an external ground-drilling spiral or threaded portion and an internal elongated axial passage with is adapted to receive said driving rod and is provided with elongated metal members embedded in the elongated cast reinforced-concrete structure along the internal elongated axial passage in diametrically opposed or approximately equiangular distance relationship and substantially

parallel with the longitudinal axis of the internal elongated axial passage such that the non-embedded portions protrude freely into the internal elongated axial passage for engagement with the driving rod, the arrangement being such that the elongated metal members can engage with the driving rod upon insertion of the driving rod into the internal elongated passage, whereby the application of torque to the driving rod causes the pile to be rotatably driven into the ground.

In preferred embodiments of the second aspect of the present invention, the combination is characterized that:

(i) said driving rod has an outer diameter approximately equal to the diameter of said internal elongated axial passage; said elongated metal members are accommodated in longitudinal grooves in said driving rod; and said elongated metal members partially embedded in the cast reinforced-concrete structure comprise flat steel bars receivable in said grooves; or

(ii) said elongated metal members partially embedded in the cast rein- forced-concrete structure comprise notched flat steel bars extending into said internal passage, said driving rod having projections which are received in said notches, more preferably said projections on said driving rod being adapted to engage with said notches: (a) so as to enable lifting of said pile by said driving rod, or (b) by rotating said driving rod relative to said flat steel bars; or

(iii) said elongated metal members partially embedded in the elongated cast reinforced-concrete structure comprise flat steel bars extending into said internal elongated axial passage, said flat steel bars having inner radial ends which define the inner diameter of

said elongated metal members partially embedded in the cast structure; said driving rod has an outer cylindrical surface which is clear of the exposed outer ends of the elongated metal members partially embedded in the elongated cast reinforced-concrete structure; and said driving rod comprises driver members which extend radially outwardly of the surface of said driving rod for engaging with said flat steel bars; or

(iv) said elongated metal members partially embedded in the elongated cast reinforced-concrete structure comprise circumferentially spaced steel bars extending into said internal elongated axial passage; said steel bars have notches opening up to the inner radial end of said steel bars; and said driving rod has circumferentially spaced radial projections, with one rotatable position in which said projections are circumferentially spaced from said notches and another rotatable position in which said projections engage with said notches.

In a third aspect, the present invention provides a method for the manufacture of a pile according to the first aspect of the present invention, characterized in that the elongated cast reinforced-concrete structure is centrifugally cast, said elongated metal members being fixed in a centrifugal casting mould during centrifugal casting such that the elongated metal members are partially embedded in the elongated cast reinforced-concrete structure to an extent that they freely protrude into the internal elongated axial passage of the elongated cast reinforced-concrete structure by a distance approximately equal to half the width of the broadest side dimension of the elongated metal members.

Thus, the objectives of the present invention are achieved by the use of the centrifugal casting process and the prestressing technique,

which result in a foundation pile with a perfectly centered interior cavity of circular cross section. In order then, however, to apply the necessary torque with the driver rod, at least two flat steel bars are fastened axially parallel in the wall of the pile with an approximately equal angular spacing, with half their width reaching into the interior cavity and serving for engagement by the driver rod.

The measure taken in accordance with the invention sets out from the fact that such flat steel bars can be fixed precisely in the centrifugal casting mold without great difficulty, so that, when the mixture is centrifuged an interior chamber of perfectly circular cross section is produced virtually automatically, and the flat steel bars become anchored in the wall of the pile such that half of their width is embedded in the wall and the other half extends into the interior cavity of the pile. A pile made in this manner has all the advantages of the centrifugal casting technique. Also, the screw threads can be made in a centrifugal casting mold with a quality previously unknown.

In the simplest case, two flat bars are set in the wall diametrically opposite one another. Of course, three bars set 120° apart could also be used, or a greater number of bars. Which method is given preference will depend on the special requirements of the individual case.

The invention opens up the possibility of simply disposing the flat steel bars in the area bearing the external screw threads. As it is known, the torque in this manner can be transmitted especially well to the pile. Another alternative is for the flat steel bars to be disposed in the upper end part of the pile. This configuration permits easier handling in the driving of the pile and permits the use of a shorter driver rod.

It lies in the scope of the invention, in the case of a foundation pile with a foot plate bearing cutters, to fasten, preferably to weld, the flat steel bars to this foot plate. The torque that is to be applied for driving then acts directly through

the foot plate on the foot of the foundation pile. Another alternative, however, is embodied in the independent inventive idea of fastening driving projections to the inside surface of the foot plate facing the interior cavity in order to engage the driver rod. This arrangement is the same as the embodiment first referred to, but in this case the flat steel bars projecting from the pile wall into the interior cavity take up only an extremely short length which is seen in the projections fastened to the foot plate. It is obvious that in this case a driver rod of correspondingly great length is necessary, but this has the advantage of better transmission of force to the tip of the pile.

In further development of the invention, notches are provided on the flat steel bars in the inwardly projecting portion in the area of their upper end for engagement by outer projections created on the driver rod. In this embodiment the driver rod is introduced into the interior of the pile until the projections on the driver rod are opposite notches of the flat steel bars. By turning the driver rod slightly, the projections enter the notches and produce a connection between the driver rod and the flat steel bars somewhat on the principle of the bayonet coupling. In this manner, tensile forces can be transmitted from the driver rod to the foundation pile so as to prevent the pile from being excessively tightened when the torque is applied to it. This renders obsolete the formerly common eyes on the head of the foundation pile which were engaged by traction means for the purpose of applying a traction force to the pile. This greatly simplifies handling when installing such foundation piling.

In further development of the basic idea of the invention, the driver rod is configured so that it approximately fills the interior cavity of the pile and has longitudinally running grooves for engaging the flat steel bars. It is obvious that these grooves and their arrangement correspond to the number and position of the flat steel bars in the interior of the pile. In this embodiment the torsion force is

spread out over a considerable length of the pile. In an alternative configuration, however, the diameter of the driver rod is smaller than the radial distance between the flat steel bars, and external drivers are disposed on the driver rod for tangentially contacting the flat steel bars and/or engaging the notches in them. In the former case a rather spot contact is made between the driver rod and the flat steel bars anchored in the wall of the pile.

The invention lastly provides that the flat steel bars embedded in the wall are held at their outer circumference by a plurality of connecting rings spaced apart axially.

Additional features, details and advantages of the invention will appear in the following description of some preferred embodiments of the invention as well as in the drawings.

Brief Description of the Drawings

Figure 1 is a side view of a foundation pile,

Figure 2 shows the bottom end of a foundation pile, also in section,

Figure 3 is a section taken along line III-III in Figure 2,

Figure 4 shows a first and

Figure 5 a second embodiment of the driver rods for cooperation with the flat steel bars extending into the internal cavity,

Figure 6 is an additional configuration of the invention in a section taken through line VI-VI in Figure 7, and

Figure 7 is a cross-sectional view taken through line VII-VII in Figure 6.

Description of the Preferred Embodiments

The foundation pile 1 consists of a shaft 2 of concrete. It is made by the centrifugal casting method and has in the area of its bottom end 3 an external thread 4 and at its bottom butt end a foot plate 5 on which cutters 6 or the like can be fastened. On the head 31 of the pile 1 two eyes 32 are provided in the embodiment here shown, which serve for the handling of the pile 1. The wall 7 of

the pile 1 has, in the case of the embodiments shown in the figures, a thickness 8, outside of which, in the embodiment shown in the drawing, the thread spirals 4 extend outward in the area of the bottom end 3. The wall 7 is provided with reinforcing bars 9. In the area of the bottom end 3 bearing the threads 4, two flat steel bars 10 are mounted in the wall such that their outer half 11 is embedded into the wall 7, while their inner half 12 extends by the width 13 into the interior cavity 14 of the pile 1. The flat steel bars 10, in the embodiment here represented, are welded at their bottom ends 15 to the foot plate 5. They are furthermore joined together by three steel rings 16, 17 and 18 disposed at a distance apart and thus they are fixed in relation to one another. The angular spacing of the two flat steel bars 10 amounts, in the embodiments represented in the drawing, to 180°.

A torque is applied to the foundation pile 1 through the driver rod 20, which in the embodiment shown in Figure 4, approximately fills the interior cavity 14. On each of two diametrically opposite sides the driver rod is provided with a notch 21 running longitudinally, which is brought into alignment with the flat steel bars 10 when the driver rod 20 is lowered, so that the bars 10 will engage the grooves 21 in the driver rod when the latter is lowered. In the embodiment shown in Figure 5, however, a substantially thinner driver rod 22 is used, on whose outer wall 23 two oppositely situated outer projections 24 are fastened, which, after the driver rod 22 has been lowered sufficiently deep, engage the flat steel bars 10 and can transfer their torque to these bars and thus to the shaft 2 of the pile 1. The diameter 25 of this driver rod 22 is slightly smaller than the distance 26 between the two flat steel bars 10.

Figures 6 and 7 show another embodiment in which notches 28 are provided in opposite arrangement in the region of the upper ends 27 of the flat steel bars 10 in the part 12 of the flat steel bars 10 protruding into the inner cavity. In a corresponding manner, external projections 29, which are intended to engage the notches 28, are fixed to the outer wall 23 of the driver rod 20 in order to be able to transfer a corresponding tensile force in the direction of the arrow 30 to the pile 1 from the driver rod.

The matter contained in each of the following claims is to be read as part of the general description of the present invention.

The claims defining the invention are as follows:

1. A reinforced-concrete foundation pile adapted to be rotatably driven into the ground by a pile driving rod, said pile being an elongated cast reinforced-concrete structure having an external ground-drilling spiral or threaded portion and an internal elongated axial passage which is adapted to receive said driving rod and is provided with elongated metal members partially embedded in the elongated cast reinforced-concrete structure along the internal elongated axial passage in diametrically opposed or approximately equiangular distance relationship and substantially parallel with the longitudinal axis of the internal elongated axial passage such that the non-embedded portions protrude freely into the internal elongated axial passage for engagement with the driving rod, the arrangement being such that the elongated metal members can engage with the driving rod upon insertion of the driving rod into the internal elongated passage, whereby the application of torque to the driving rod causes the pile to be rotatably driven into the ground.

2. A pile according to Claim 1, wherein said elongated cast reinforced-concrete structure is a centrifugally cast reinforced-concrete structure or a centrifugally cast pre-stressed reinforced-concrete structure.

3. A pile according to Claim 1 or 2, wherein said elongated metal members comprise flat steel bars partially embedded in the elongated cast reinforced-concrete structure such that they freely protrude into the internal elongated axial passage by a distance approximately equal to half the width of the broadest side dimension of said bars.

4. A pile according to any one of Claims 1 to 3, wherein said elongated cast reinforced-concrete structure has a longitudinal bottom end portion and a longitudinal top end portion, said spiral or threaded portion being located at said bottom end portion for said bottom end portion to enter the ground first.

5. A pile according to Claim 4, wherein said elongated metal members are disposed along said bottom end portion.

6. A pile according to Claim 4, wherein said elongated metal members are disposed along said top end portion.

7. A pile according to any one of claims 1 to 6 wherein said elongated metal members are connected by traverse rings that are spaced apart from each other in the axial direction of the pile and are affixed to the outer edges of said elongated metal members where they are embedded in the cast reinforced-concrete structure.

8. A pile according to any one of Claims 1 to 7 further comprising a foot plate means having cutters connected to said elongated metal members.

9. A pile according to Claim 8, wherein said foot plate means comprises a plate which is generally perpendicular to the axis of the pile, said plate having an inner surface and an outer surface, said cutters being on said outer surface, and said elongated metal members being connected to said inner surface.

10. A pile according to Claim 8 or 9, wherein said foot plate means is fastened by welding to said elongated metal members.

11. The combination comprising a reinforced-concrete foundation pile and a pile driving rod for rotatably driving the reinforced-concrete pile into the ground, said pile being an elongated cast reinforced-concrete structure having an external ground-drilling spiral or threaded portion and an internal elongated axial passage with is adapted to receive said driving rod and is provided with elongated metal members

embedded in the elongated cast reinforced-concrete structure along the internal elongated axial passage in diametrically opposed or approximately equiangular distance relationship and substantially parallel with the longitudinal axis of the internal elongated axial passage such that the non-embedded portions protrude freely into the internal elongated axial passage for engagement with the driving rod, the arrangement being such that the elonagated metal members can engage with the driving rod upon insertion of the driving rod into the internal elongated passage, whereby the application of torque to the driving rod causes the pile to be rotatably driven into the ground.

12. The combination according to Claim 11, wherein said driving rod has an outer diameter approximately equal to the diameter of said internal elongated axial passage; said elongated metal members are accommodated in longitudinal grooves in said driving rod; and said elongated metal members partially embedded in the cast reinforced-concrete structure comprise flat steel bars receivable in said grooves.

13. The combination according to Claim 12, wherein said elongated metal members partially embedded in the cast reinforced-concrete structure comprise notched flat steel bars extending into said internal passage, said driving rod having projections which are received in said notches.

14. The combination according to Claim 13, wherein said projections on said driving rod are adapted to engage with said notches so as to enable lifting of said pile by said driving rod.

15. The combination of Claim 13, wherein said projections on said driving rod are adapted to engage with said notches by rotating said driving rod relative to said flat steel bars.

16. The combination according to Claim 11, wherein said elongated metal members partially embedded in the elongated cast reinforced-concrete structure comprise flat steel bars extending into said internal elongated axial passage, said flat steel bars having inner radial ends which define the inner diameter of said elongated metal members partially embedded in the cast structure; said driving rod has an outer cylindrical surface which is clear of the exposed outer ends of the elongated metal members partially embedded in the elongated cast reinforced-concrete structure; and said driving rod comprises driver members which extend radially outwardly of the surface of said driving rod for engaging with said flat steel bars.

17. The combination according to Claim 16, wherein said elongated metal members partially embedded in the elongated cast reinforced-concrete structure comprise circumferentially spaced steel bars extending into said internal elongated axial passage; said steel bars have notches opening up to the inner radial end of said steel bars; and said driving rod has circumferentially spaced radial projections, with one rotatable position in which said projections are circumferentially spaced from said notches and another rotatable position in which said projections engage with said notches.

18. A pile according to Claim 1, substantially as hereinbefore described with reference to any one of the respective embodiments illustrated in the accompanying drawings.

19. A combination according to Claim 11, substantially as hereinbefore described with reference to any one of the respective embodiments illustrated in the accompanying drawings.

20. A method for the manufacture of a pile according to Claim 1, characterized in that the elongated cast reinforced-concrete structure is centrifugally cast, said elongated metal members being fixed in a centrifugal casting mould during centrifugal casting such that the elongated metal members are partially embedded in the elongated cast reinforced-concrete structure to an extent that they freely protrude into the internal elongated axial passage of the elongated cast reinforced-concrete structure by a distance approximately equal to half the width of the broadest side dimension of the elongated metal members.

DATED this 7th day of December 1992

PFLEIDERER VERKEHRSTECHNIK GmbH
& CO. KG,
By its Patent Attorneys,
E. F. WELLINGTON & CO.,
By:

(B. S. Wellington)

C/KA/7274/13

ABSTRACT

The present invention provides: (i) a foundation pile, preferably of reinforced prestressed concrete, having external screw threads and an interior cavity for the engagement of a driver rod to apply torque, at least two flat steel bars being fastened axially parallel in the pile wall at approximately equal angular spacing, and extending by about half of their width freely into the cavity serving for the engagement of the driver rod; and (ii) the combination of such a foundation pile and a driving rod for driving the pile into the ground.

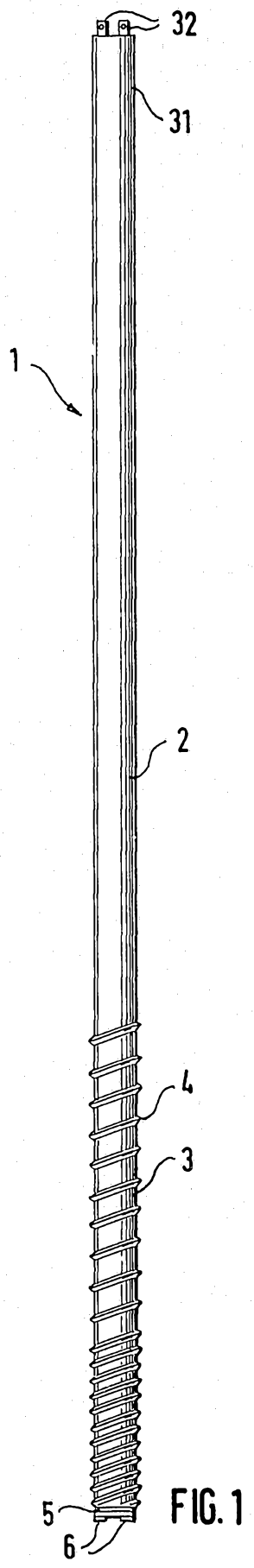

FIG. 1

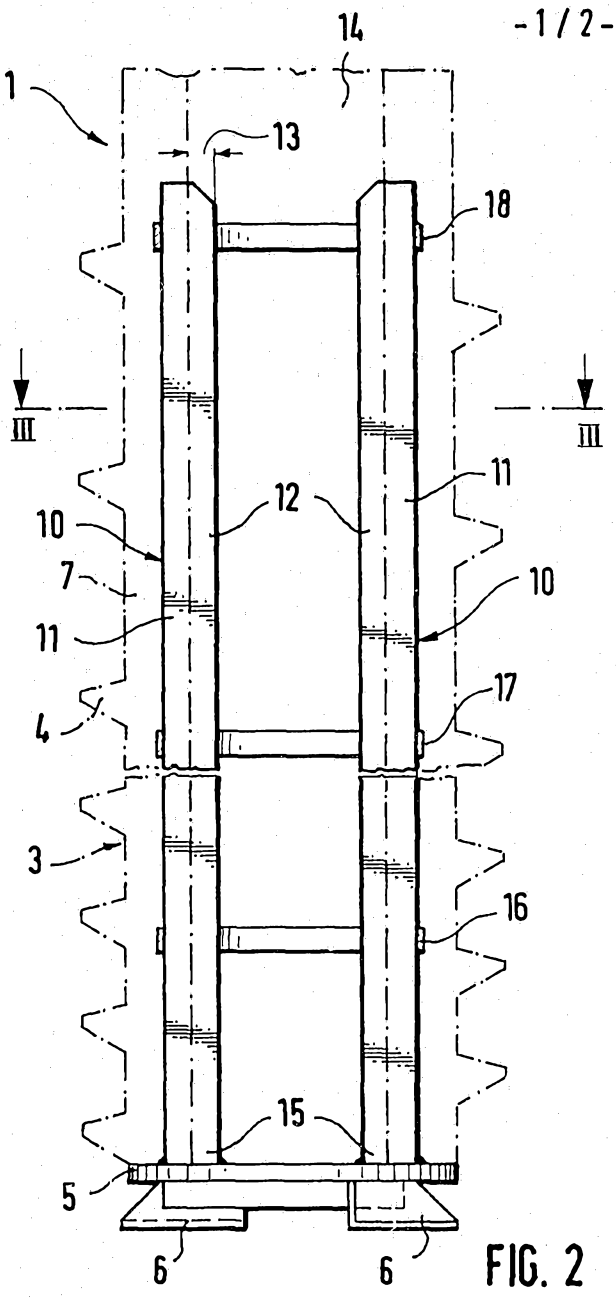

FIG. 2

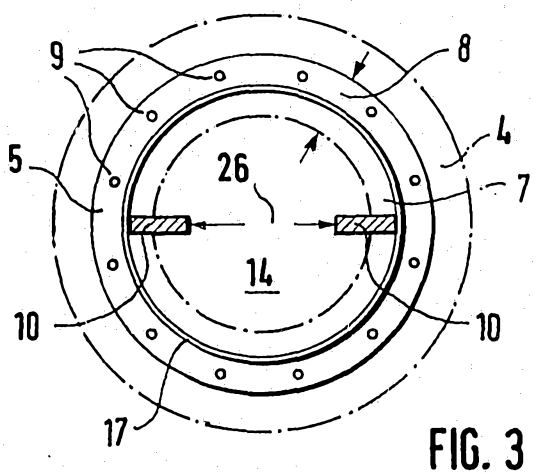

FIG. 3

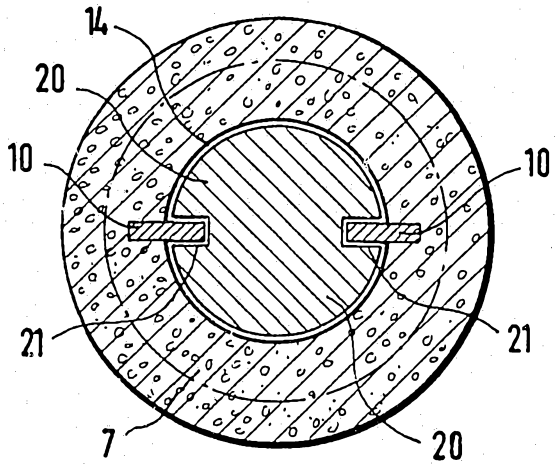

FIG. 4

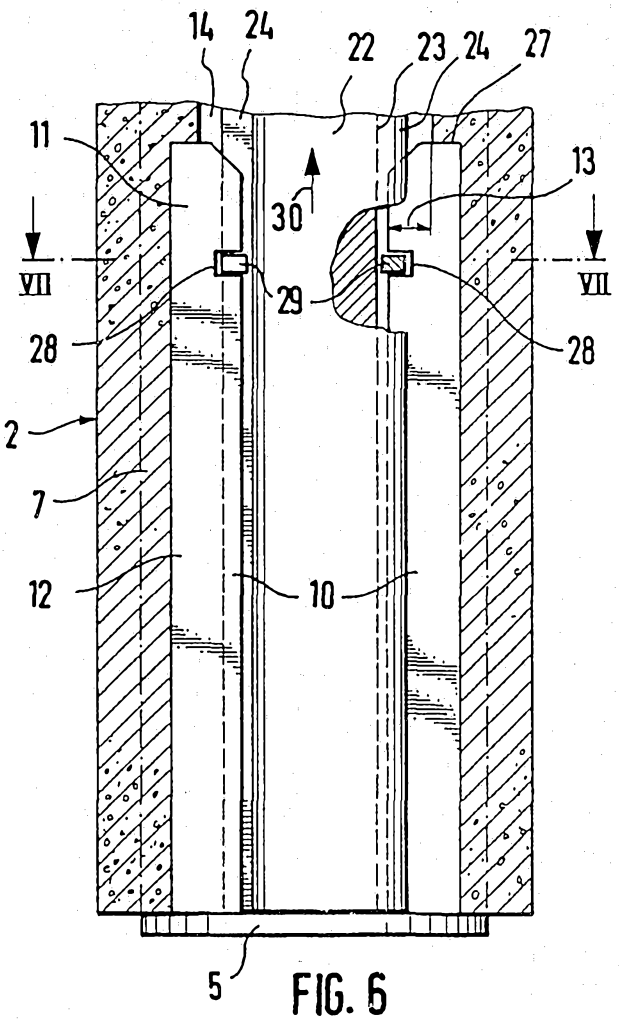

FIG. 6

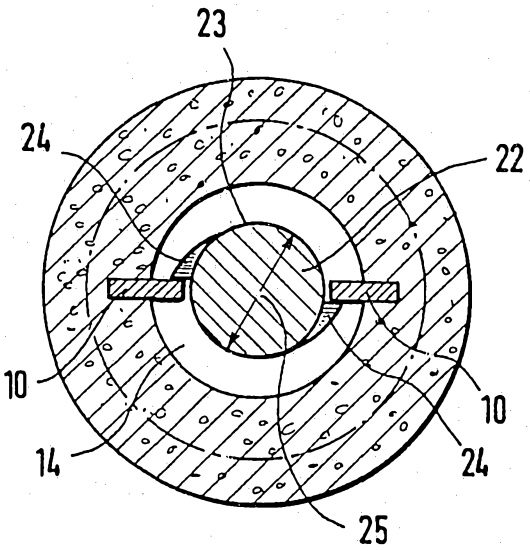

FIG. 5

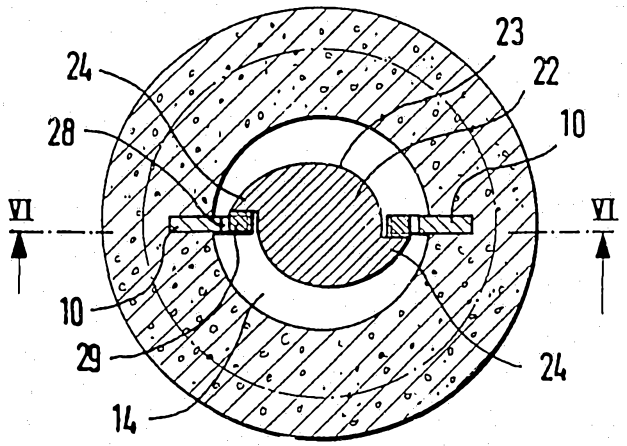

FIG. 7