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(54) **Title: WIND TURBINE**

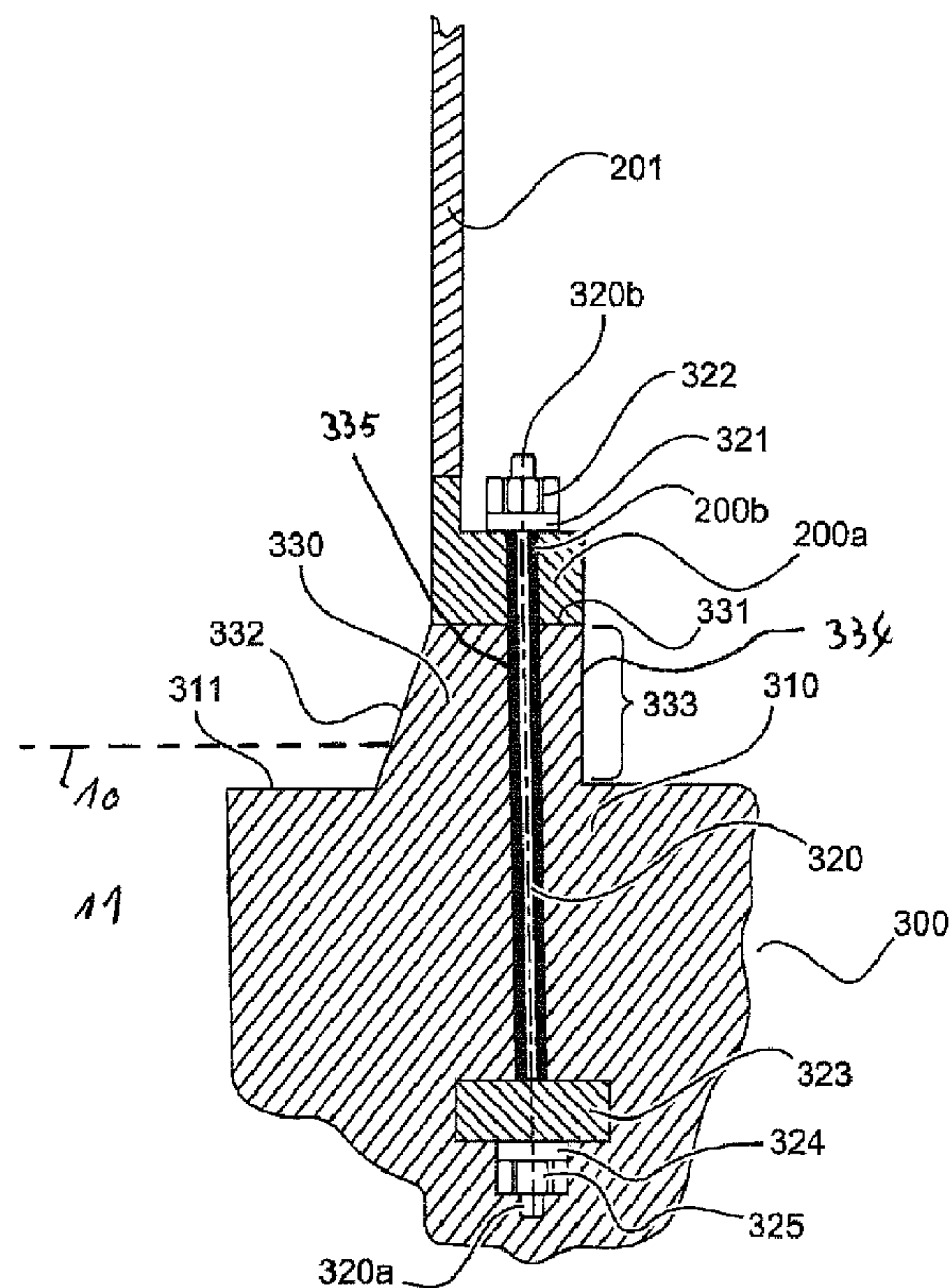


Fig. 2

(57) **Abrégé/Abstract:**

The invention relates to a wind turbine having a foundation (300). The foundation (300) has a first foundation segment (310) having a top side (311) and a concrete foundation pedestal (330) having a top side (331). The top side (331) of the concrete

(57) Abrégé(suite)/Abstract(continued):

foundation pedestal (330) is annular and protrudes beyond the top side (331) of the first foundation segment (310). The wind turbine also has a steel tower (200) having a plurality of tower segments (201-206), wherein a lower tower segment (201) has a flange (200a) having a plurality of through-bores (200b). The flange (200a) is placed on a top side (331) of the concrete foundation (330). The wind turbine also has a plurality of clamping elements (320, 302). A lower end (320a, 302a) of the clamping elements (320, 302) is fastened in or below the first foundation segment (310) by means of a fastening unit (325, 325a). An upper end (320b, 302b) of the clamping elements (320b, 302b) protrudes beyond an upper end (331) of the concrete foundation pedestal (330) and extends through the through-holes (200b). The upper ends (320b, 302b) of the clamping elements (320b, 302b) are stressed by means of fastening units (321, 321a, 322). An outer face (332) of the concrete foundation base (330) is conical.

Abstract

There is provided a wind turbine having a foundation (100). The foundation (100) has a first foundation portion (310) having a top side (311) and a concrete foundation pedestal (330) having a top side (331).
5 The top side (331) of the concrete foundation pedestal (330) is annular and projects beyond the top side (311) of the first foundation portion (310). The wind turbine also has a steel tower (200) having a plurality of tower segments (201-206), wherein a lower tower segment (201) has a flange (200a) having a plurality of through bores (200b). The flange (200a) is placed on a top side (331) of the concrete foundation (330). The wind turbine further has a plurality of clamping elements (220, 220a). A lower end (320a, 302a) of the clamping elements (320, 302) is fixed by means of a fixing unit (325, 325a) in or under the first foundation portion (310). An
10 upper end (320b, 302b) of the clamping elements (320b, 302b) projects beyond an upper end (331) of the concrete foundation pedestal (330) and extends through the through holes (200b). The upper ends (320b, 302b) of the clamping elements (320b, 302b) are braced by means of fixing units (321, 321a, 322). An outward side (332) of the concrete foundation
15 pedestal (330) is of a conical configuration.
20

(Figure 2)

5

10

Wind turbine

15 The present invention concerns a wind turbine.

Before a tower of a wind turbine is erected it is necessary to provide a suitable concrete foundation in the ground. The foundation is typically cast with concrete on site (in-situ concrete). After the concrete has set a first segment of the tower of the wind turbine can be placed on the
20 foundation.

WO 2012/035206 A1 shows a wind turbine and a foundation of a wind turbine.

On the German patent application from which priority is claimed the German Patent and Trade Mark Office searched the following documents:
25 DE 10 2007 060 379 B4, DE 10 2013 211 750 A1, DE 20 2009 013 844 U1, EP 2 375 057 A1, EP 2 821 565 A1, WO 2012/035 206 A1, CN 203 924 104 U1 and CN 203924104 U.

An object of the present invention is to provide a wind turbine and a tower of a wind turbine having an improved foundation.

30 That object is attained by a wind turbine according to claim 1.

Thus there is provided a wind turbine having a foundation. The foundation has a first foundation portion having a top side and a concrete foundation pedestal having a top side. The top side of the concrete foundation pedestal is annular and projects beyond the top side of the first
35 foundation portion. The wind turbine also has a steel tower having a plurality of tower segments, wherein a lower tower segment has a flange having a plurality of through bores. The flange is placed on a top side of the concrete foundation. The wind turbine further has a plurality of

clamping elements. A lower end of the clamping elements is fixed by means of a fixing unit in or under the first foundation portion. An upper end of the clamping elements projects beyond an upper end of the concrete foundation pedestal and extends through the through holes. The upper
5 ends of the clamping elements are braced by means of fixing units. An outward side of the concrete foundation pedestal is of a conical configuration. Provided in the concrete pedestal and in the foundation portion is a plurality of bores for receiving the clamping elements. The bores in the region of the concrete pedestal are through bores, through the
10 entire height of the concrete pedestal.

According to an aspect of the present invention the clamping elements are in the form of threaded rods or in the form of stressing wire strands.

According to a further aspect of the present invention the height of
15 the concrete foundation pedestal is greater than 2 m.

Further configurations of the invention are subject-matter of the appendant claims.

Advantages and embodiments by way of example of the invention are described in greater detail hereinafter with reference to the drawing.

20 Figure 1 shows a diagrammatic view of a wind turbine according to the invention,

Figure 2 shows a diagrammatic sectional view of a wind turbine foundation according to a first embodiment, and

Figure 3 shows a diagrammatic sectional view of a wind turbine
25 foundation according to a second embodiment.

Figure 1 shows a diagrammatic view of a wind turbine according to the invention. The wind turbine 100 has a tower 200 and a pod 104.

The tower 200 comprises a plurality of tower segments 201 – 206. The tower segments 201 – 206 are produced in particular from steel.
30 Provided on the pod 104 is a rotor 106 having (three) rotor blades 108 and a spinner 110. In operation of the wind turbine the rotor 106 is caused to rotate by the wind and thus also rotates a rotor or rotor member of an electric generator in the pod 104. The pitch angles of the rotor blades 108

can be varied by pitch motors at the rotor blade roots of the respective rotor blades 108.

Figure 2 shows a diagrammatic sectional view of a wind turbine foundation according to a first embodiment. A lower tower segment 201 of steel is placed on a foundation 300. The lower tower segment 201 has a
5 flange 200a having a plurality of through bores 200b.

The foundation 300 can represent for example a foundation made of in-situ concrete. As an alternative thereto it is also possible to use a prefabricated concrete foundation. The foundation 300 has a foundation
10 portion 310 and a concrete foundation pedestal 330. The foundation portion 310 has an upper edge or an upper end 311. The concrete foundation pedestal 330 projects beyond the upper edge 311. The flange 200a of the lower tower segment 201 is placed at a top side 331 of the concrete foundation pedestal 330. The concrete foundation pedestal 330
15 can be annular. The concrete foundation pedestal 330 can be concreted on to the upper edge 311 of the foundation portion 310. That concrete foundation pedestal 330 can also replace a lower tower portion.

The concrete pedestal 310 is of a conical configuration at its outward side 332 and is of a height 333 above the upper edge 311. An inward side
20 334 of the concrete pedestal 330 can be straight. The concrete foundation pedestal 300 has a plurality of through holes or bores 335 for receiving clamping elements 320. The pedestal 330 projects beyond a ground level 10 of the ground 11 in the region of the foundation (that is to say around the foundation).

25 The through bores 335 extend along the entire height of the concrete foundation pedestal 330.

A plurality of threaded rods 320 can be provided in the concrete foundation 300, wherein a lower end 320a of the threaded rod 320 is fixed by means of a plate 323, a washer 334 and a (hexagonal) nut 325. The
30 other or upper end 320b of the threaded rod 320 projects beyond the upper end 331 of the concrete pedestal 330. The flange 200a has a plurality of through bores 200b. The through holes 200b are placed over the upper

ends 320b of the threaded rods 320 and the flange 200a can be fixed for example by means of a plurality of washers 321 and nuts 322.

The concrete pedestal 330 and the flange 200a can be of an annular configuration.

5 Figure 3 shows a sectional view of a wind turbine foundation according to a second embodiment. A concrete foundation 300 has a first concrete foundation portion 310 having an upper end 311. The foundation 300 further has a concrete pedestal 330 which extends above the upper end 311 and has an upper end 331. The upper end 331 of the pedestal
10 330 can be in particular of a circular or annular configuration. A plate 323 or a ring 323 can be provided beneath the first foundation portion 310. Provided in the foundation is a plurality of clamping units like stressing wire strands 302, the lower ends 302a of which are held by means of a fixed anchor 325a. A tensioning anchor 322a can be provided at the upper end
15 302b of the stressing wire strand 302. The lower flange 200a of the lower tower segment 201 can be fixed to the foundation by means of the stressing wire strand 320a, the fixed anchor 325a and the tensioning anchor 322a.

 The concrete pedestal 310 is of a conical configuration at its outward
20 side 332 and is of a height 333 above the upper edge 311. An inward side 334 of the concrete pedestal 330 can be straight. The concrete foundation pedestal 300 has a plurality of through holes 335 for receiving clamping elements 320. The through bores 335 extend along the overall height of the concrete foundation pedestal 330. The pedestal 330 projects beyond a
25 ground level 10 of the ground 11 in the region of the foundation (that is to say around the foundation).

 The concrete foundation portion 310 can be in the form of in-situ concrete or in the form of a precast (concrete) foundation. The concrete foundation pedestal 310 is of a conical configuration, that is to say the
30 outside diameter of the lower end 334 is larger than the outside diameter of the upper end 331. The transmission of load of the tower 200 to the foundation 300 can be improved or optimised by virtue of the larger outside

diameter at the lower end while the outside diameter of the lower tower portion can be reduced, which is advantageous in regard to transport.

The height 333 of the foundation pedestal 310 can correspond to a height of a lower tower segment (that is to say for example > 3m) so that the lower tower segment 201 can be at least partially replaced by a higher foundation pedestal 310.

The conical configuration of the concrete foundation pedestal 330 means that it is possible to increase a diameter, that is structurally and/or statically necessary, in respect of the transition between the pedestal and the foundation portion. Nonetheless the diameter of the upper end of the pedestal (and thus the diameter of the lower tower segment) can be reduced, more specifically to a degree less than the maximum width for on-land transport operations.

According to an aspect of the invention an underside of the flange 200a of the lower tower segment is placed directly on a top side 331 of the concrete foundation pedestal 330, which projects beyond an upper side of a first foundation portion 310.

According to the invention a single-row screw means or stressing means for the lower tower segment 201 is provided. According to the invention the through holes 200b in the flange 200a are provided within the wall of the lower tower segment so that the screw means or stressing means is provided within the wall of the lower tower segment and the stressing means is thus protected from the influences of the weather. As an alternative thereto a dual-row screw means is also possible. In that case the lower flange could be in the form of a T-flange.

Optionally the top side 311 of the foundation portion can correspond to a ground level so that the pedestal 330 projects above the ground level.

CLAIMS

1. A wind turbine (100) comprising
 - 5 a foundation (300), wherein the foundation (300) has a first foundation portion (310) having a top side (311) and a concrete foundation pedestal (330) having a top side (331),
wherein the top side (331) of the concrete foundation pedestal (330) is annular and projects beyond the top side (311) of the first foundation
10 portion (310),
a steel tower (200) having a plurality of tower segments (201 – 206), wherein a lower tower segment (201) has a flange (200a) having a plurality of through bores (200b),
wherein the flange (200a) is placed on a top side (331) of the
15 concrete foundation pedestal (330),
a plurality of clamping elements (220, 220a), wherein lower ends (320a, 302a) of the clamping elements (320, 302) are fixed by means of first fixing units (325, 325a) in or under the first foundation portion (310),
wherein upper ends (320b, 302b) of the clamping elements (320,
20 302) project beyond the upper end (331) of the concrete foundation pedestal and extend through the through bores (200b),
wherein the upper ends (320b, 302b) of the clamping elements (320b, 302b) are braced by means of second fixing units (321, 321a, 322),
wherein at least an outward side (332) of the concrete foundation
25 pedestal (330) is conical,
wherein a plurality of bores (335) for receiving the clamping elements (220, 220a) is provided in the concrete foundation pedestal (330) and in the foundation portion (310),
wherein the bores (335) in the region of the concrete foundation
30 pedestal (330) are through bores (335).
2. A wind turbine according to claim 1 wherein
the clamping elements (320, 320a) are in the form of threaded rods (320) or stressed wire strands (320a).

3. A wind turbine according to claim 1 or claim 2 wherein
a height (333) of the concrete foundation pedestal (330) is greater
than 2 m.

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4. A method of erecting a wind turbine comprising the steps:
providing a foundation (300) which has a foundation portion (310)
having a top side (311) and a concrete foundation pedestal (330) having a
top side (311),

10 wherein the top side (311) of the concrete foundation pedestal (330)
is annular and projects beyond the top side (311) of the first foundation
portion (310),

placing a steel tower (200) having a plurality of tower segments (211
– 206) on the foundation,

15 wherein a lower tower segment (201) has a flange (200a) having a
plurality of through bores (200b),

placing the flange (200a) on the top side (331) of the concrete
foundation pedestal (330),

fixing lower ends (320a, 302a) of a plurality of clamping elements
20 (220, 220a) by means of first fixing units (325, 325a) in or under the
foundation portion (310),

wherein the upper ends (320b, 302b) of the plurality of clamping
elements (320, 302) project beyond the upper end (331) of the concrete
foundation pedestal (330) and extend through the through bores (200b) in
25 the flange (200a),

bracing the upper ends (320b, 302b) of the plurality of clamping
elements (320b, 302b) by means of second fixing units (321, 321a, 322),

wherein at least an outward side (332) of the concrete foundation
pedestal (330) is conical,

30 wherein a plurality of bores (335) for receiving the clamping
elements (220, 220a) is provided in the concrete foundation pedestal and
in the foundation portion (310),

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wherein the bores (335) in the region of the concrete foundation pedestal (330) are through bores (335).

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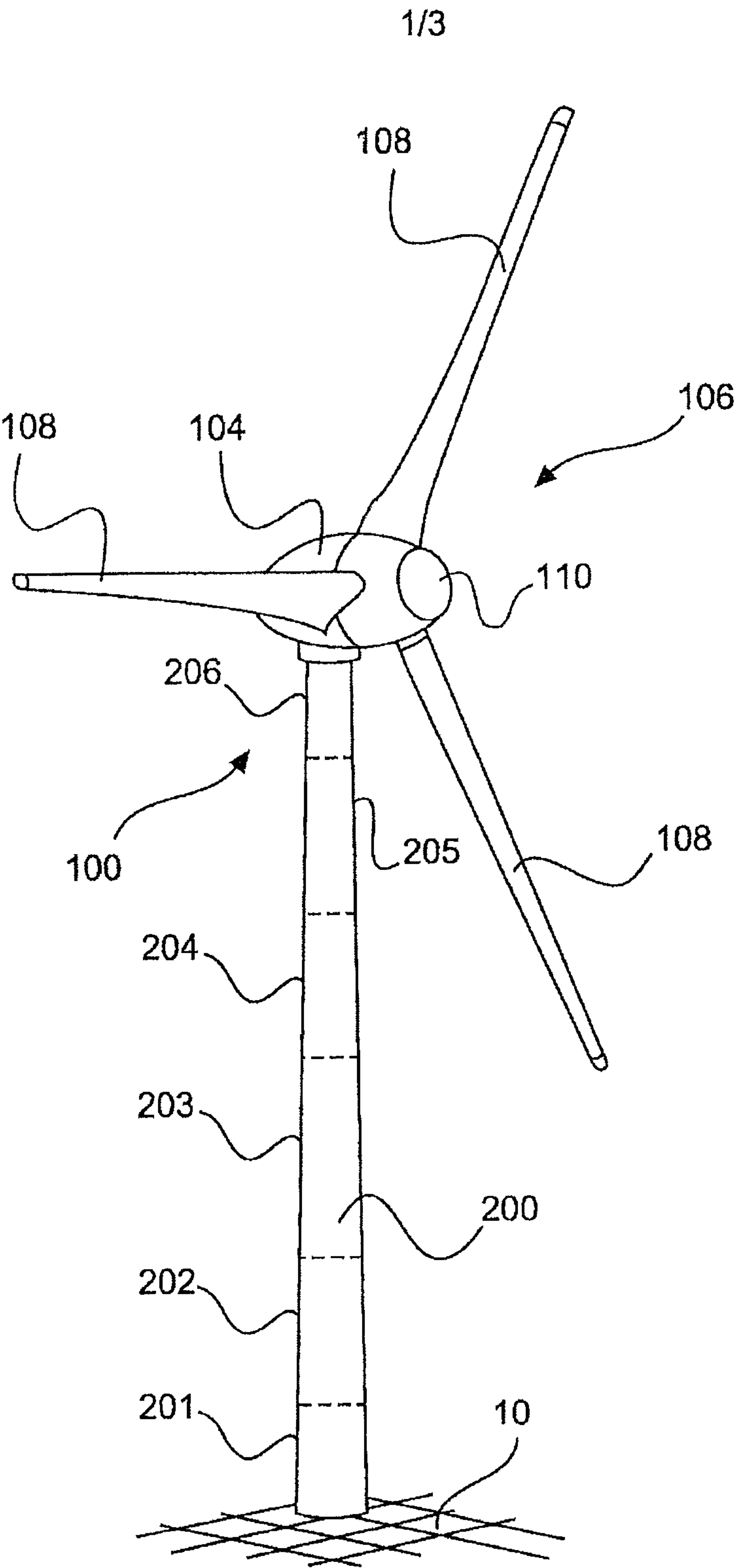


Fig. 1

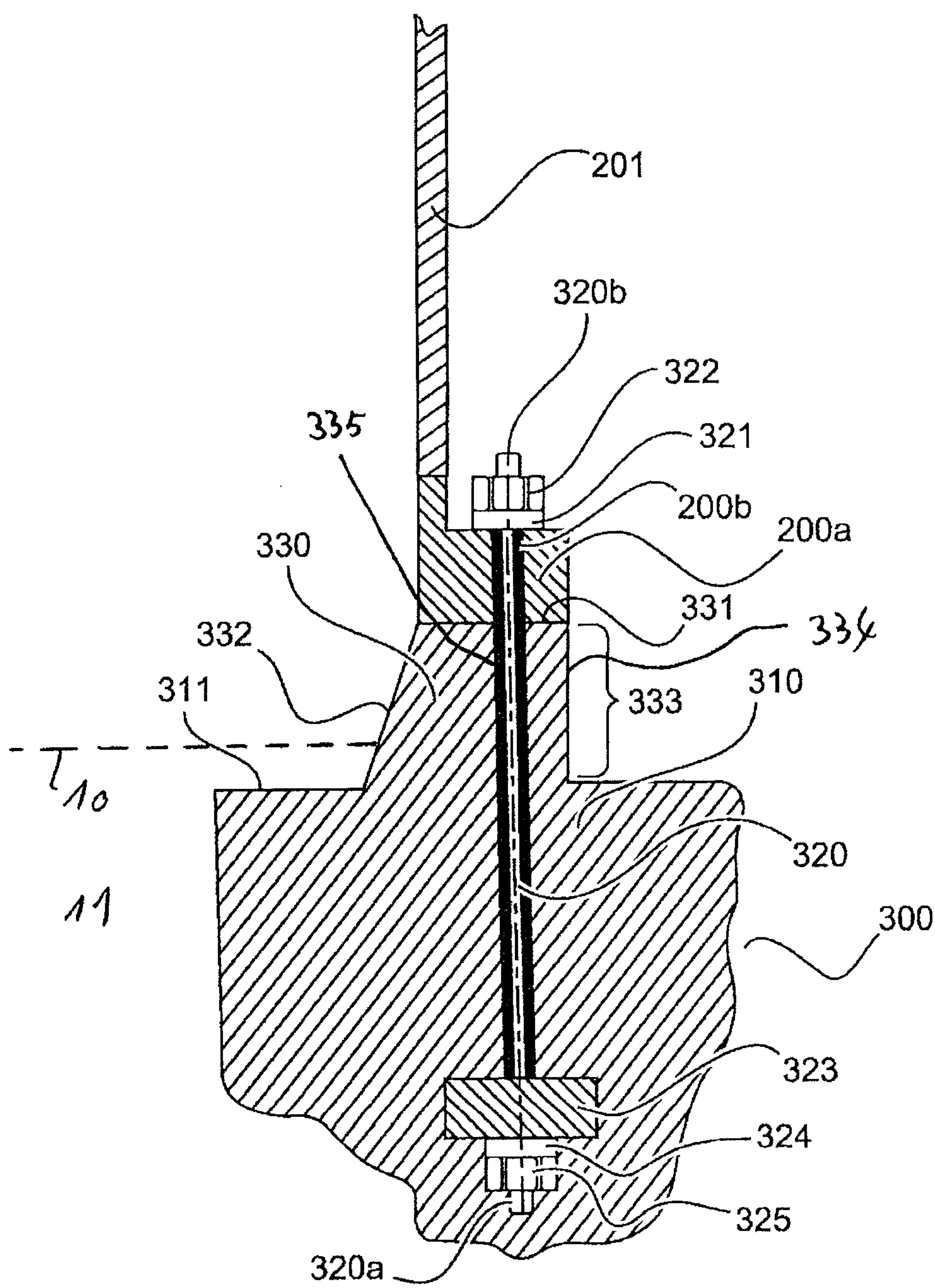


Fig. 2

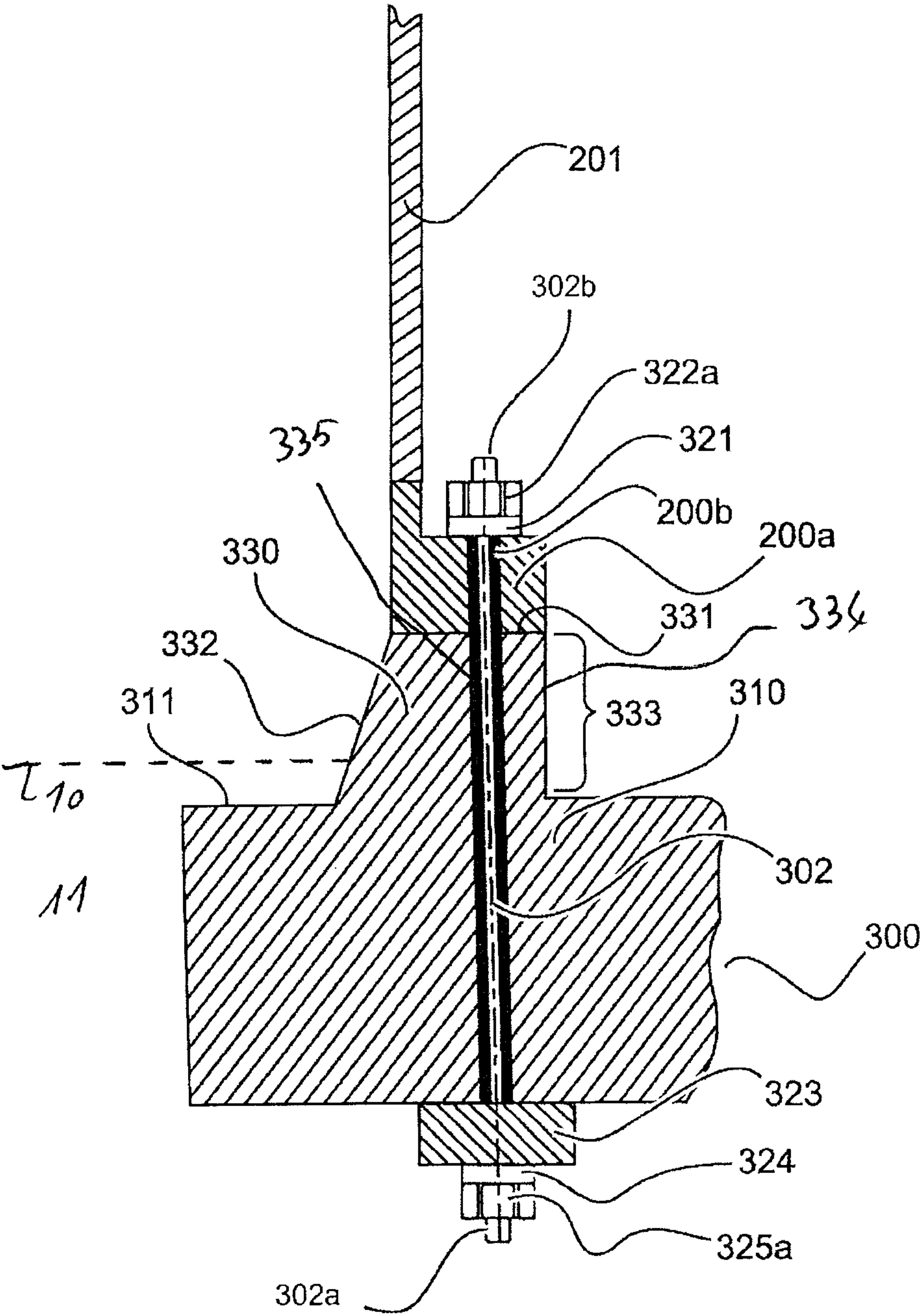


Fig. 3



Fig. 2