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- (54) Title:** WIND POWER GENERATOR

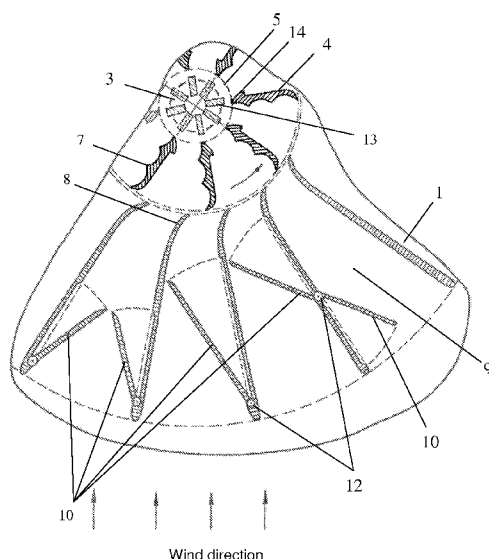


Figure 2

(57) Abstract: The present invention relates to the field of wind power, and can be used in wind-power-operated plants for producing energy, primarily electricity. The wind power generator contains a rotor on a vertical axis of rotation, said rotor being placed within a fixed stator of wind guide plates and being formed by blades attached to a supporting cylinder, the blades forming a slit aperture along their bases between themselves and the supporting cylinder, with each of the blades having longitudinal main swirlers along the front of its plane in the form of delta-shaped or I-shaped projections perpendicular to the plane of the blades; and on the rear of the plane of each of the blades, on its vertical edge closest to the supporting cylinder axis, there is an auxiliary swirler in the form of a longitudinal thickening with a delta-shaped cross-section; each wind guide plate is arranged radially along the axis of the rotor, is flat with a gradual bend in the narrow part of the confuser channel formed by the adjacent wind guide plates to direct the flow of air running onto the wind power generator at an angle of 80°-90° to the longitudinal cross-section of the rotor blade, and has at least one plate turned by a drive, said plate being located along the surface of the wind guide plate with an axis of rotation parallel to the axis of the rotor, while the supporting cylinder has extendable plates arranged radially and installed so that they can be displaced radially and can close off or alter the size of the slit aperture between the supporting cylinder and each of the rotor blades. As a result, the wind power generator achieves higher efficiency, and its operation at high wind speeds and for use with high-power wind energy generators is optimized.

WIND POWER GENERATOR

Field of the invention

The invention relates to the field of wind power, and can be used in wind-power-operated plants for producing energy, primarily electricity.

5 Prior art

There are known wind power generators containing a wind turbine rotor with mainly curved blades and a stator made with mainly bent wind guide plates fully or partly encompassing the rotor, enabling the wind flow to run smoothly onto the curved rotor blades (e.g. SU 1721285 A1, 1992; RU 2215898 C1, 2003; RU 2249722 C1, 2005; US
10 6309172 B1, 2001; DE 19739921, 1999; GB 2049066 A, 1980; FR 2811720 A1, 2002; EP 1096144 A2, 2001; WO 91/19093, 1991).

However, all these are insufficiently effective, since they do not enable the maximum efficiency to be achieved and do not ensure the necessary operability when wind speed is low.

15 There are also known technical solutions, consisting of adding auxiliary elements to the rotor blades - thickenings of the aerofoil and segment profiles, interceptors or recesses (RU 2182258 C2, 1996; RU 2073113 C1, 1997; and RU 2120564 C1, 1998 respectively), claiming higher efficiency in the use of wind power. However, the increase in efficiency achieved by using them is in practice quite negligible; furthermore, other indicators of
20 wind power devices are worsened. For example, making recesses in the front of the rotor blades has no significant effect on the efficiency of use of wind power, since from a design point of view, it is impractical for such recesses to have the required dimensions. If they are made bigger, this leads to loss of strength and deterioration in the weight characteristics of the rotor.

25 There is also a known wind power generator containing a rotor within a fixed stator of guide plates, with a vertical axis of rotation, formed by blades attached to a supporting cylinder so that a slit diffuser is formed between the blades and the supporting cylinder, each blade having on the front of its plane main swirlers (See RU Patent for Useful Model № 86672 U1, 2009). In this wind power generator, the blades are flat, and the swirlers are
30 in the form of bent, predominantly cylindrical, strips. The swirlers provide additional take-up of the energy of mechanical motion of the air flow, including that part of it which slides off the blades after they have turned through a certain angle. Furthermore, the oncoming

flow of air to the swirlers in the form of bent strips on the flat rotor blades is swirled, which leads to a slowing of the air flow, and as a result of this, to the taking of additional energy from it, this energy being passed to the rotor. This somewhat improves the efficiency of the wind power generator.

5 However, this still does not achieve high efficiency due to the inadequate geometry of the rotor blades preventing the air flow energy being used as efficiently as it could be.

 The closest wind power generator to the invention in terms of technical substance and result achieved is a wind power generator containing a rotor within a fixed stator of guide plates, with a vertical axis of rotation, formed by blades attached to a supporting cylinder
10 so that a slit diffuser is formed between the blades and the supporting cylinder, each blade having on the front of its plane main swirlers formed by projections extending along the swirlers perpendicular to the plane of the blades, which are delta-shaped or I-shaped; the side facets of the delta-shaped projections are concave or flat, and on the rear of the plane of each of the blades, on the vertical edge closest to the supporting cylinder of the axis,
15 there is an auxiliary swirler in the form of a longitudinal thickening of delta-shaped cross section, with a convex side facet facing the bearing cylinder of the rotor (see RU Patent for Invention № 2422673, cl. F 03D 3/06, 26.06.2011).

 However, in this wind power generator, not enough use is made of the possibilities for improving efficiency and optimizing the operation of the rotor at high wind speeds and for
20 high-power wind power generators.

Summary of the invention

 The problem being solved by the invention is the creation of a wind power generator without the defects of the prior art.

 The technical result provided by the invention consists of raising the efficiency of the
25 wind power generator and optimizing its operation.

 This problem is solved, and the technical result achieved, by the fact that the wind power generator has a rotor on a vertical axis of rotation within a fixed stator of wind guide plates and formed by blades attached to a supporting cylinder, forming a slit aperture along their bases between themselves and the supporting cylinder; each of the blades preferably
30 having longitudinal main swirlers along the front of its plane, in the form of delta-shaped or I-shaped projections perpendicular to the plane of the blades; furthermore, the side facets of the delta-shaped projection are concave or flat, and on the rear of the plane of

each of the blades, on its vertical edge closest to the supporting cylinder axis, there is an auxiliary swirler in the form of a longitudinal thickening of delta shape in its cross section, with a convex side facet facing the rotor supporting cylinder; each wind guide plate is arranged radially along the axis of the rotor and is made flat with a gradual bend in the narrow part of the confuser channel formed by the adjacent wind guide plates to direct the flow of air running onto the wind power generator at an angle of 80° - 90° to the longitudinal section of the rotor blade, and has at least one plate turned by a drive, said plate being arranged along the surface of the wind guide plate with an axis of rotation parallel to the axis of the rotor. Preferably, the supporting cylinder has extendable plates arranged radially and installed so that they can be displaced radially to close off or alter the size of the slit aperture between the supporting cylinder and each of the rotor blades.

The axis of rotation of each rotating plate may be arranged in the middle part of the cross section of the wind guide plate, which has on it two rotating plates arranged either side of the wind guide plate.

The axis of rotation of each rotating plate may be arranged on the side of the entry sector of the wind guide plate, which has on it one rotating plate or two rotating plates arranged either side of the wind guide plate.

Brief description of the figures

The technical result described above is achieved by the combination of all the significant features.

Fig. 1 shows the structural layout of the wind power generator.

Fig. 2 shows a cross section of the wind power generator with three possible variants of the design of the guide plates and the system for optimizing the operation of the rotor.

Detailed description of the invention

The wind power generator comprises a rotor with a vertical axis of rotation inside a fixed stator composed of wind guide plates (1). The rotor may have a diameter of e.g. 70 cm, and the stator of wind guide plates a diameter of 1.2 m; their height (length), may be e.g. 2.2 m. Wind guide plates (1) are arranged between fixed toroid rings (2). The rotor is formed by blades (4) attached to supporting cylinder (3). They form slit aperture (5) between themselves and supporting cylinder (3). Supporting cylinder (3) is mounted in bearings (6), and is mechanically connected to a converter of the mechanical energy of the rotor into electricity, e.g. to a magneto-electric generator (not shown). Each blade (4) has

longitudinal main swirlers on the front of its plane. The swirlers are in the form of delta-shaped or I-shaped projections (7) perpendicular to the plane of blades (4). The side facets of the delta-shaped projections are concave or flat. On the rear of the plane of each of the blades, on its vertical edge closest to the supporting cylinder of the axis, there is an auxiliary swirler in the form of a longitudinal thickening (14) of delta-shape cross section, with a convex side facet facing the supporting cylinder of the rotor. Projections (7, 14) may be made e.g. in one with blades (4), or may be independent elements fixed firmly to blades (4). The height of each of the projections (7, 14) is usually from 1:5 to 1:10 in relation to the width of blade (4). Blades (4) may be solid (all metal) or hollow. They may be made e.g. in the form of three-dimensional hollow structures of thin metal by the pressing method. The cavity in hollow blades (4) may be filled with a polymer foam filler such as solid foam polystyrene.

Each wind guide plate (1) is set radially along the axis of the rotor, is hollow, and has a smooth bend (8) in the narrow part of the confuser channel (9) formed by adjacent wind guide plates (1) to guide the flow of air running onto the wind power generator at an angle of 80°-90° to the longitudinal section of rotor blade (4), and has at least one rotating plate (10) turned by a drive (not shown), said plate being arranged along the surface of wind guide plate (1) with axis of rotation (12) parallel to the axis of the rotor. Supporting cylinder (3) has extendable plates (13) arranged radially and able to be displaced radially to close off or alter the size of slit aperture (5) between bearing cylinder (3) and each of the rotor blades (4).

Axis of rotation (13) of each rotating plate (12) may be arranged in the middle part of the cross section of wind guide plates (1), on which are mounted two rotating plates (12) arranged either side of wind guide plate (1), or the axis of rotation (13) of each turning plate (12) may be arranged on the entry sector of wind guide plate (1), the latter having on it one rotating plate (12) or two rotating plates (12) either side of wind guide plate (1) (see Fig. 2, where all the variants described above are shown).

The wind power generator operates in the following manner.

The wind flow runs onto wind guide plates (1), is accelerated on them and flows onto blades (4) of the rotor, so that the device accomplishes useful work by the rotation of the rotor. Furthermore, the air flow exerts direct pressure on blades (4), between which a high pressure zone is created. The presence of slit aperture (5) enables possible breakaway of

the airflow in this zone to be prevented - such breakaway, if it occurred, would reduce the effective working area of blades (4), by removing the compacting of the air from the space between the blades. The excess pressure is passed through slit aperture (5) into the space beyond the blade, which is a low pressure zone forming a vortex cavity. Extendable plates (13) make it possible to alter or close off the slit aperture and thus to regulate the pressure difference created on each blade (4), and consequently, to regulate the rotor operating regime. The main swirlers on the front of blades (4) serve for additional take-off of the energy of mechanical motion of the air flow, including that part of it which slides off blades (4) after they have turned through a certain angle. The flow of air coming onto the main swirlers in the form of projections (7) is swirled by the projections, slowing it down, and thus taking off additional energy from the air flow and passing it to the rotor. Furthermore, the shape and dimensions of projections (7) exert significant influence on vortex formation (turbulence induction). Projections (7) assist swirl formation on the front of blades (4) for different vectors of the oncoming air flow, which raises the efficiency of the rotor. The height of projections (7) is determined for the specific design of the wind power generator, e.g. experimentally, by the increase in efficiency. Their number is selected depending on the power output for which the rotor of the wind power generator is designed.

The fact that the channel made between wind guide plates (1) is a confuser makes it possible to reduce the proportion of the overall volume of the rotor relative to the stator formed by wind guide plates (1), and consequently to reduce the weight of the rotor for high power wind power generators. This has a beneficial effect on friction losses in the bearing groups, reducing them accordingly. The air flow entering the confuser channel is speeded up in it as it passes through due to the narrowing of the cross section in the confuser channel (equalizing the continuity of the jet), then changes the direction of the flow vector, due to the bend in wind guide plate (1), towards the frontal surface of rotor blades (4), and goes onto blades (4) at an angle of 80° - 90° to the longitudinal section of rotor blade (4), enabling maximum use to be made of the kinetic energy of the air flow for conversion into mechanical work. As the speed of the oncoming air flow increases, so does the generation of electricity in the electric generator. To prevent gusts of wind of more than 30 m/sec overloading the rotor and causing it to break, rotating plates (10) are installed in the gap of the confuser channel formed by wind guide plates (1), at its entrance

or in the middle part of it. The rotating plates can regulate the passage section of the confuser channel and thus also the flow rate of the incoming air flow (see Fig. 2). As the wind speed increases above the permissible value, rotating plates (10) are diverted to close off part or all of the passage section of the confuser channel. The rotating plates (10) may
5 be turned by electromechanical, pneumatic or hydraulic rotating mechanisms. Thus, the parameters of the rotor are optimized for each wind speed value by altering the width of slit aperture (5) and the passage section of the confuser channel formed by wind guide plates (10).

This is how the technical result of the invention, i.e. raising the efficiency of the wind
10 power generator and optimizing the operation of the rotor, is achieved.

A wind power generator made in accordance with the invention has efficiency 15-20% higher by comparison with analogous known ones. It is more efficient to use and cheaper to make.

This invention can be used everywhere that it is possible to utilize wind energy to
15 produce mechanical energy and/or electricity.

CLAIMS

1. A wind power generator, comprising a rotor on a vertical axis of rotation,
said rotor

- being placed within a fixed stator of wind guide plates (1) and

- 5 - comprising a supporting cylinder (3) and rotor blades (4) attached thereto, the rotor blades (4) forming a slit aperture (5) along their bases between themselves and the supporting cylinder (3); each of the rotor blades (4) having longitudinal main swirlers (7) along the front of its plane in the form of delta-shaped or I-shaped projections perpendicular to the plane of the blades; the side facets of the delta-shaped projection are
10 concave or flat;

each wind guide plate (1) being arranged substantially radially along the axis of the rotor and being flat with a gradual bend in the narrow part of a confuser channel formed by adjacent wind guide plates (1) to direct the flow of air running onto the wind power generator at an angle of 80°-90° to the longitudinal section of the rotor blades (4), and
15 having at least one rotating plate (10) turned by a drive, said plate being located along the surface of the wind guide plate (1) with an axis of rotation (12) parallel to the axis of the rotor.

2. A wind power generator according to Claim 1, wherein the supporting cylinder has extendable plates (13) arranged radially and installed so that they can be displaced radially
20 and able to close off or alter the size of the slit aperture (5) between the supporting cylinder and each of the rotor blades (4).

3. A wind power generator according to Claim 1, wherein a rear of a plane of each of the rotor blades (4), on its vertical edge closest to the supporting cylinder axis, comprises an auxiliary swirler (14) in the form of a longitudinal thickening with a delta-shaped cross-
25 section and a convex side facet facing the rotor supporting cylinder.

4. A wind power generator according to Claim 1, wherein the axis of rotation of each rotating plate (10) is located in the middle part of the cross-section of the wind guide plate (1), or a wind guide plate (1) comprises two rotating plates (10) located on either side of the wind guide plate (1).

- 30 5. A wind power generator according to Claim 1, wherein the axis of rotation of each rotating plate (10) is located on the side of the entrance section of the wind guide plate (1).

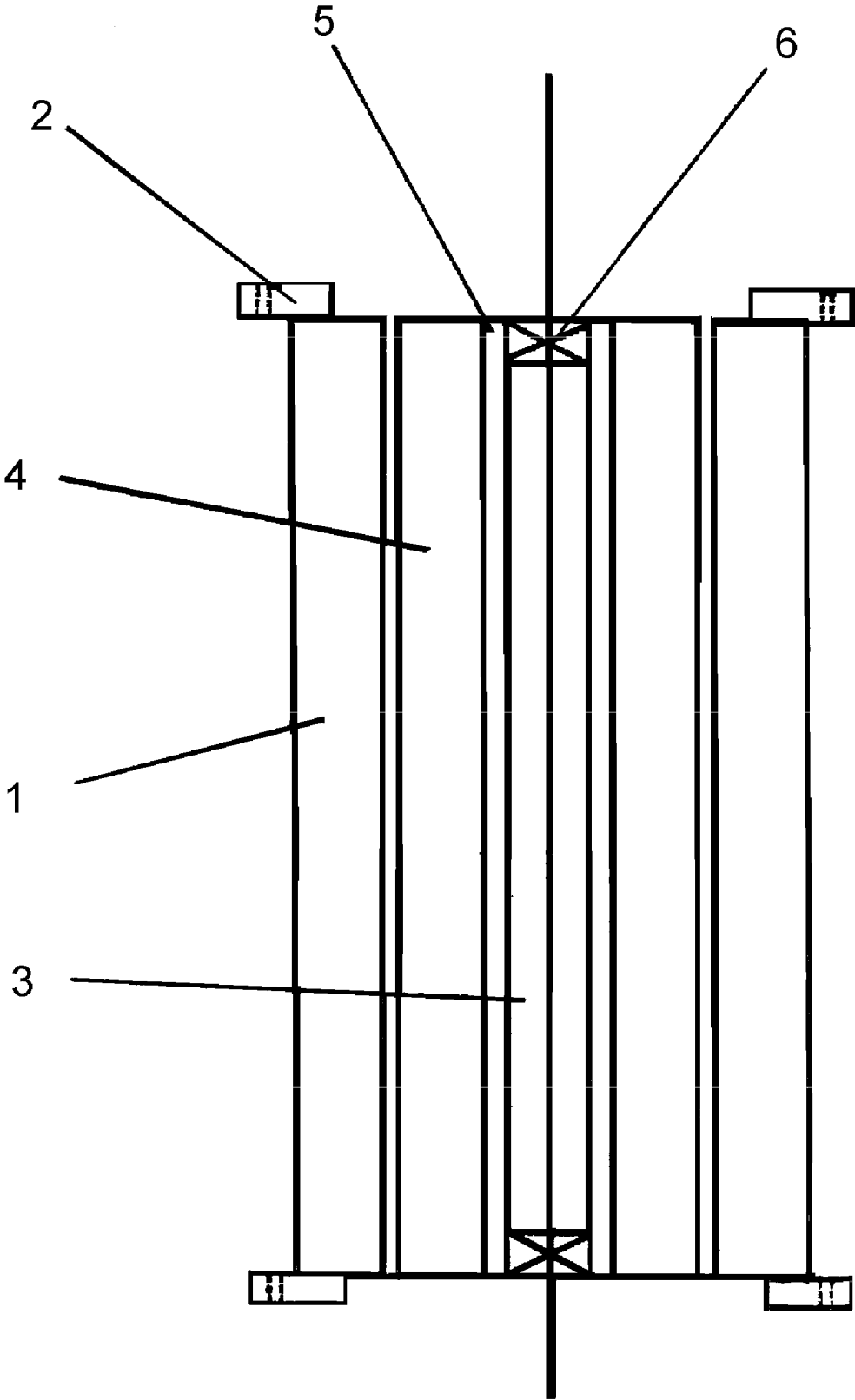


FIGURE 1

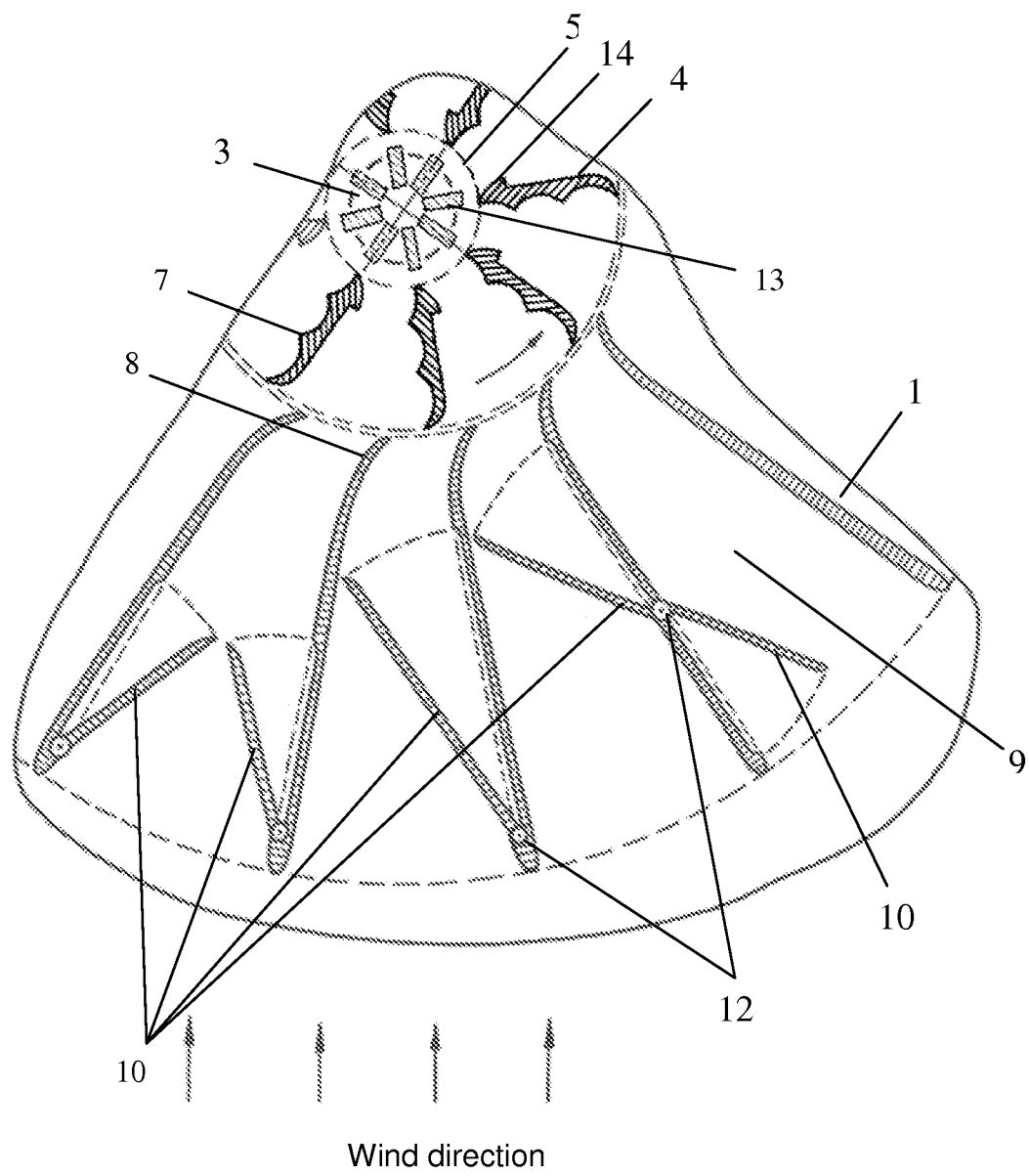


Figure 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/051197

A. CLASSIFICATION OF SUBJECT MATTER

INV. F03D3/00 F03D3/04 F03D3/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 330 295 A2 (FUNG GIN DA ENERGY SCIENCE AND TECHNOLOGY CO LTD [TW]) 8 June 2011 (2011-06-08) figures 7-14	1-5
A	FR 2 546 239 A1 (GIL MICHEL [FR]) 23 November 1984 (1984-11-23) page 3 - page 5; figures 4-11	1,4,5
A	WO 2010/123400 A1 (VIGAEV VALERIY PETROVICH [RU]; MIKHOV ALEXANDER PETROVICH [RU]) 28 October 2010 (2010-10-28) figures 3-6	1-5
A	JP 59 103973 A (TSUTSUMI MICHIAKI) 15 June 1984 (1984-06-15) the whole document	1-5

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/051197

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