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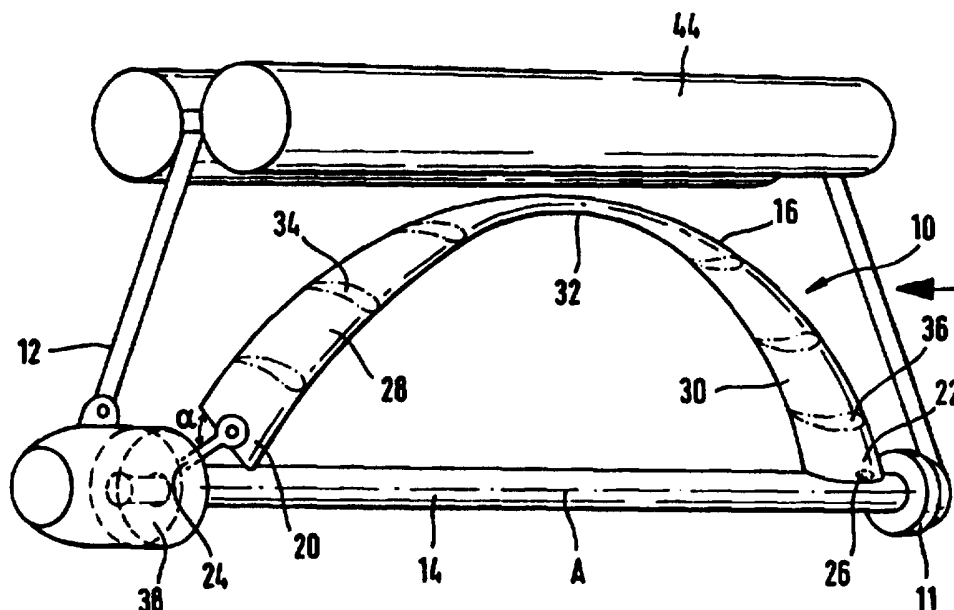
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(54) Title: FLOW ENGINE

**(57) Abstract**

Disclosed is a flow engine having a rotor (10) which includes a support (12), a shaft (14) and at least one vane (16) attached to the shaft (14). The vane (16) is strip-shaped and extends lengthwise of the axis of rotation (A) and is curved in on itself in such a manner that the vane (16) when viewed in the direction of the axis of rotation (A) has the shape of a loop (18) or approximately the shape of one-half or a portion of one-half of a figure eight. By virtue of this specific vane configuration, the flow engine can operate independently of the in-flow direction and can receive this in-flow in the axial direction as well as diagonally or perpendicularly thereto. The vane configuration provides a high turning moment even in slowly flowing water or in light wind. Due to its specific construction, the engine can be easily deployed and can be made very compact and even portable. It is even possible to pack the flow engine, for example, in luggage and to utilize it wherever natural flows occur.

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FLOW ENGINE**DESCRIPTION****Technical Field**

The invention relates to a flow engine of the kind disclosed in the preamble of patent claim 1.

Background Art

Such a flow engine (or flow-powered engine) is known in the form of a wind-powered engine from Meyer's Enzyklopädisches Lexikon (English translation: Encyclopedic Lexicon), 9th edition (1979) Volume 25, page 398.

Flow engines, such as for example wind-powered engines and water-powered engines serve to utilize the natural energy of air or water flows. In the case of water-powered engines, its principal components are water wheels or water turbines, in the case of wind-powered engines, they are surfaces (vanes, buckets, etc.) attached to a shaft and oriented diagonally to the wind direction. Flow engines can be used, for example, for irrigation and dewatering, for water supply, for the production of electric current, but also for driving mills or saw mills. Most water-powered engines as, for example, water-powered generators, have the drawback that effective utilization of the water power necessitates extensive structural modifications in order to alter the path of a water course for improved utilization. This frequently results in significant environmental damage. The population's increasing environmental awareness leads to an increasing desire to seek out possible ways to transform natural energy into useful energy without environmental damage. In particular, one endeavors to find better and better ways

of utilizing the natural energy of flowing water without significantly affecting its path. An additional example of the transformation of natural energy essentially without environmental damage is, for example, the utilization of air currents which is known from the previously mentioned Meyer's Encyclopedia. The wind-powered engines used for that purpose require, for improved utilization of the flow, that they be oriented in the direction of the flow. The orientation in flow direction is achieved by means of a tail fin on the cross-piece, or by means of a positioning motor coupled to a flow vane. In any case, the known flow engines are bulky and of complicated construction. The need for flow direction control leads to added weight, apparatus complexity and increased manufacturing costs. Consequently, the known flow-powered installations are mostly stationary and cannot be transported.

Disclosure of the Invention

It is the object of the invention to provide a flow engine of the kind disclosed in the preamble of patent claim 1 and so constructed that it can operate independently of the direction of in-flow, is of simple construction, and is readily transportable.

This object is achieved in accordance with the invention by the characterizing portions of patent claim 1.

In a flow engine according to the invention, it is essential that there be attached to the shaft of a rotor mounted on a support at least one strip-shaped vane which extends bow-like in both the radial direction and the direction of the

axis of rotation of the shaft. Viewed in the direction of the axis of rotation, the vane has the shape of a loop, or approximately the shape of one-half, or a portion of one-half of a figure eight. Because of this specific vane construction, the flow engine according to the invention can operate independently of the in-flow direction. The in-flow can take place in the axial direction, as well as diagonally or transversely thereto. The vane construction produces a high turning moment even in a light flow as, for example, a slow flowing stream or a light wind. Because of the low resistance which the specially shaped vane offers to rotation, high rates of rotation are also possible. The particularly simple configuration makes possible a very light-weight construction. Furthermore, the apparatus can be made very small and compact and even portable by virtue of its particular construction. It is therefore possible to pack the flow engine according to the invention inside luggage, for example, and to utilize it wherever natural flows occur.

In the particularly advantageous embodiment according to patent claim 2, the vane of the flow powered engine is attached at both ends to attachment points which are spaced apart lengthwise of the shaft. This creates especially great stability for the apparatus, accompanied by light-weight construction.

In the preferred embodiment according to patent claim 3, the vane is made flexible. As a result, in the disassembled state, the vane occupies only a very small space, thereby enhancing the transportability of the flow engine.

In the preferred embodiment according to patent claim 4, the spacing between the two points at which the two ends of the vane are attached, is made

adjustable. This creates the advantage that the radius of curvature of the bow can be adjusted and with it the diameter of the rotor. In this way, the rotor can be adapted to various flow conditions.

In the particularly preferred embodiment of the invention according to patent claim 5, a first portion of the vane is inclined opposite to the direction of rotation and thereby extends opposite to the direction of rotation out of a plane defined by the axis of rotation and the peak of the bow of the vane, and is provided with a vane cross-section which is curved outwardly, i.e. an outwardly convex vane cross-section. This serves to enhance the turning moment (or torque), so that even a light flow can be sufficient for power production.

The energy transformation takes place even more effectively using a flow engine embodying the invention according to patent claim 6, in that a second portion of the vane is inclined in the direction of rotation and thereby extends in the direction of rotation out of the plane defined by the axis of rotation and the peak of the bow, and is provided with a vane cross-section which is curved inwardly, i.e. is inwardly convex.

When the flow engine is equipped with a generator in the embodiment claimed in patent claim 7, the flow engine can be used to produce electric current. This makes it possible, for example, to utilize the flow engine to produce current, e.g. to charge storage batteries during jungle expeditions, or similar undertakings.

An especially compact configuration is achieved by attaching the generator directly to the shaft in the embodiment according to claim 8.

The compactness of the engine is enhanced by forming the housing of the generator integrally with the support structure in the embodiment of the invention according to patent claim 9.

In a further preferred embodiment of the invention according to patent claim 10, the orientation angle of the vane with respect to the flow is made variable. This is done especially simply by making the orientation angle of the vane adjustable at least at one end. By virtue of this adjustability of the angle of orientation, the flow engine can be especially well adapted to various flow conditions.

The embodiment of the flow engine according to the invention with adjustable angle of orientation according to patent claims 11 and 12 is of especially simple and uncomplicated construction, is light and inexpensive to manufacture and also very easy to maintain.

An especially light construction of the flow engine is achieved by making the vane according to patent claim 13 of a metal-reinforced synthetic plastic.

If the flow engine is made disassemblable and/or collapsible in the preferred embodiment according to patent claim 14, it can be stored easily anywhere and is also very easily transportable.

In the preferred embodiment according to patent claim 15, the flow engine can be used as a wind-powered engine or in the preferred embodiment according to patent claim 16 for the transformation of hydromechanical energy. Thus, it can be used, for example, in wind or in any relatively large creek for the transformation

of air or water flow energy into other useful energy, e.g. electrical energy.

If the flow engine embodying the invention is provided with flotation bodies in the preferred embodiment according to patent claim 17, and not fixedly attached as is customary in known flow engines, then the flow engine accommodates itself to the prevailing water conditions when used for the transformation of hydromechanical energy.

By virtue of the turning moment which is produced, the flow engine according to the invention is completely stable. Light attaching means suffice to hold it in place.

Brief Description of the Drawings

Preferred exemplary embodiments of the invention are further described in what follows with reference to the drawings. There is shown in

Fig. 1 a perspective side view of a flow engine according to the invention,

Fig. 2 the flow engine viewed in the direction of the axis of rotation,

Fig. 3 a top view of a detail of one way of attaching a vane of the flow engine, and

Fig. 4 the attachment according to Fig. 3 viewed in the direction of the axis of rotation.

Best Mode of Carrying Out The Invention

Figure 1 shows a flow engine having a rotor 10. The rotor 10 has a shaft 14 to which a vane 16 is attached. The shaft is rotatably mounted on a support which is collectively designated with reference numeral 12. In the example

illustrated, the support consists of bracketry which is attached at the top to two flotation bodies 44 and at the bottom supports the rotor 10 and an electrical generator 38 coupled thereto. The shaft 14 of the rotor can be a separate shaft coupled to the shaft of the generator 38, or it can consist of an extended drive shaft of the generator 38. In either case, the generator 38 provides the rotating bearing at the left end of shaft 14. At the right end, the shaft 14 is rotatably mounted in a separate bearing 11 which is attached to support 12.

The vane 16 of rotor 10 which is attached to shaft 14 takes the form of a stiff, elastically bendable strip and extends along an axis of rotation A of shaft 14 and in addition bow-like radially with respect to axis of rotation A, as can be seen in Figure 1. Furthermore, according to the illustration in Fig. 2, the vane 16 is curved inwardly on itself in such a manner that, when viewed in the direction of axis of rotation A, it takes the shape of a loop 18 or approximately the shape of one-half of a figure eight. Figure 2 shows that the vane 16 extends radially away from shaft 14 and initially also away from a plane E, but then curves back again toward plane E, crosses same at a peak 32 and then correspondingly curves away from plane E and toward the shaft 14 again.

In Fig. 1 there is shown only a single vane. There can be used at least a second vane which is shown in dashed lines in Fig. 2 below the axis of rotation A.

Vane 16 is attached at its left end 20 and its right end 22 to respective attachment points 24 and 26 which are spaced apart along shaft 14. The relative spacing of attachment points 24, 26 is adjustable (by means of apparatus which is

not illustrated). In this manner the rotor diameter is adjustable and can therefore be conformed to the prevailing water flow conditions.

In the exemplary embodiment shown in Fig. 1, the flow engine is used as a transformer for transforming the hydromechanical energy of water flow into other useful energy, namely electrical energy. In similar manner, the flow engine can be used as a wind-powered engine. In that case, the flotation bodies 44 are unnecessary and are replaced, for example, simply by a suspension structure.

Vane 16 of rotor 10 can have a flat cross-sectional portion, i.e. a cross-sectional portion without airfoil cross-section. In the exemplary embodiment, the vane 16 does have an airfoil cross-section. Thus a first portion 28 of vane 16 projects out of the plane E (Fig. 2), which is defined by axis of rotation A and the peak 32 of the bow of the vane, opposite to the direction of rotation D and exhibits with respect to the axis of rotation A a vane cross-section 34 which is curved outwardly, i.e. outwardly convex. A second portion 30 of vane 16 extends out of the plane E, which is defined by the axis of rotation A and the peak 32 of the bow of the vane in the direction of rotation D and exhibits a vane cross-section 36 which is curved inwardly relative to the axis of rotation A, i.e. inwardly convex, as can be seen in Fig. 1.

The angle of attack α of vane 16 is adjustable at least at one of the ends 20, 22 of the vane. As illustrated in Figs. 3 and 4 a bolt 40 is attached to the vane 16, by means of which the angle of attack α is adjustable. The bolt 40 is adjustable in its lengthwise direction in order to adjust the angle of attack α , it is

fixedly attached to vane 16, it is inclined diagonally to shaft 14, and its pretensioned at its bearing end 42 where it bears against shaft 14, as can readily be seen from Figs. 3 and 4. The vane can be made of a synthetic plastic sheet reinforced with metal which, as previously mentioned, can be provided with or without airfoil cross-section.

The support 12 and an outer housing of electric generator 38 can be formed integrally with the support 12. Preferably, the flow engine is made so that it can be disassembled and/or collapsed for transportation. It can therefore be desirable to provide a hinged connection between the support 12 and the outer housing of the generator 38, as indicated in Fig. 1.

The previously described flow engine constitutes a miniature power plant, which is easily transportable and can be installed without much effort in wind or water streams. The rotor, which can have one, two or more than two vanes, can rotate independently of the in-flow direction. Thus it is possible to operate the flow engine independently of position (horizontal or vertical). Since the attachment points of the vane to the shaft are adjustable in their location, the rotor diameter can be adjusted. A lesser spacing between the adjustment points creates a greater rotor diameter and therefore a higher turning moment with lower rate of rotation.

When the flow engine is provided with only one vane 16, as shown in Fig. 1, there must be provided a mass compensator (not shown), on the side of the axis of rotation A which is opposite to the vane.

In the previously described illustrative embodiment, the angle of attack of

the vane is easily adjustable, namely by means of the bolt provided at right angles to the vane and which bears against the shaft. The angle of attack is changed by shortening or lengthening the bolt. The limits of the angle of attack are established by having the bolt either completely tangential or almost nearly perpendicular to the shaft. The effect is further intensified by the fact that the bolt is positioned in plane E diagonally to the axis. The vane adjustment makes it possible to incline the vane steeply with respect to the flow, in which case the rate of rotation is low and the turning moment high. In contrast, if the vane 16 is inclined at a small angle to the flow, there results a high rate of rotation and a low turning moment.

At a high rate of rotation of rotor 10, the flow engine is completely stationary due to conservation of the turning moment. The flow engine can be positioned across the direction flow or lengthwise of same.

The vane 16 can consist, for example, of a polycarbonate plastic sheet, which is provided outwardly with an airfoil cross-section and is reinforced inwardly by a spring steel strap (not shown).

The shaft 14 which is shown in Fig. 1 as being a continuous piece, extending between ends 20 and 22, can be interrupted in its central region. Indeed it would suffice to make the shaft 14 at the left extend far enough out of the drive shaft of generator 38 so that the first attachment point 24 can be appropriately moved around, and at the right it would be correspondingly necessary to provide, at rotational bearing 11 or in place of rotational bearing 11, a sufficiently long shaft stub on which the right end 22 of vane 16 can be

rotationally supported, or a long enough shaft stub which is supported for rotation in rotational bearing 11 and is attached to the second end 22 of vane 16 at the other end.

Patent Claims

1. Flow engine having a rotor (10) which includes a support (12), a shaft (14) and at least one vane (16) attached to the shaft (14), characterized in that the vane (16) is strip-shaped and extends lengthwise of the axis of rotation (A) of the shaft (14) and furthermore extends bow-like radially with respect to the axis of rotation (A) and is curved in on itself in such a manner that the vane (16), viewed in the direction of the axis of rotation (A) takes the shape of a loop (18), or approximately the shape of one-half or a portion of one-half of a figure eight.
2. Flow engine according to claim 1, characterized in that the vane (16) is flexible.
3. Flow engine according to claim 1 or 2, characterized in that the vane (16) is attached at both ends (20, 22) to attachment points (24, 26), spaced from each other along the shaft (14).
4. Flow engine according to claim 3, characterized in that the spacing of the attachment points (24, 26) is adjustable.
5. Flow engine according to one of claims 1 to 4, characterized in that a first portion (28) of the vane (16) extends out of a plane (E), which is defined by the axis of rotation (A) and the peak (32) of the bow, opposite to the direction of rotation (D) and has an outwardly curved airfoil cross-section (34) relative to the axis of rotation (A).
6. Flow engine according to one of claims 1 to 5, characterized in that a second portion (30) of the vane (16) extends out of a plane (E), which is defined

by the axis of rotation (A) and the peak (32) of the bow, in the direction of rotation (D) and has an airfoil cross-section (36) which is curved inwardly relative to the axis of rotation (A).

7. Flow engine according to one of claims 1 to 6, characterized in that an electric generator (38) is coupled to the shaft (14).

8. Flow engine according to claim 7, characterized in that the generator (38) is attached directly to the shaft (14).

9. Flow engine according to claim 7 or 8, characterized in that the support (12) is constructed integrally with the housing of the generator (38).

10. Flow engine according to one of claims 1 to 9, characterized in that an angle of attack (α) of the vane (16) is adjustable at at least one of its ends (20, 22).

11. Flow engine according to claim 10, characterized in that at least one bolt (40) is attached to the vane (16), by means of which the angle of attack (α) is adjustable.

12. Flow engine according to claim 11, characterized in that the bolt (40) for adjusting the angle of attack (α) is adjustable in its lengthwise direction, is fixedly attached to the vane (16), is inclined diagonally to the shaft (14) and is pretensioned by virtue of its bearing end (42) bearing against the shaft (14).

13. Flow engine according to one of claims 1 to 12, characterized in that the vane (16) is made of a metal-reinforced plastic.

14. Flow engine according to one of claims 1 to 13, characterized in that

it is constructed so as to be disassemblable and/or collapsible for transportation.

15. Flow engine according to one of claims 1 to 14, characterized by its use as a wind-powered engine.

16. Flow engine according to one of claims 1 to 14 characterized by its utilization as a transformer for transforming hydromechanical energy.

17. Flow engine according to claim 16, characterized in that the support (12) is attached to one or more flotation bodies (44).

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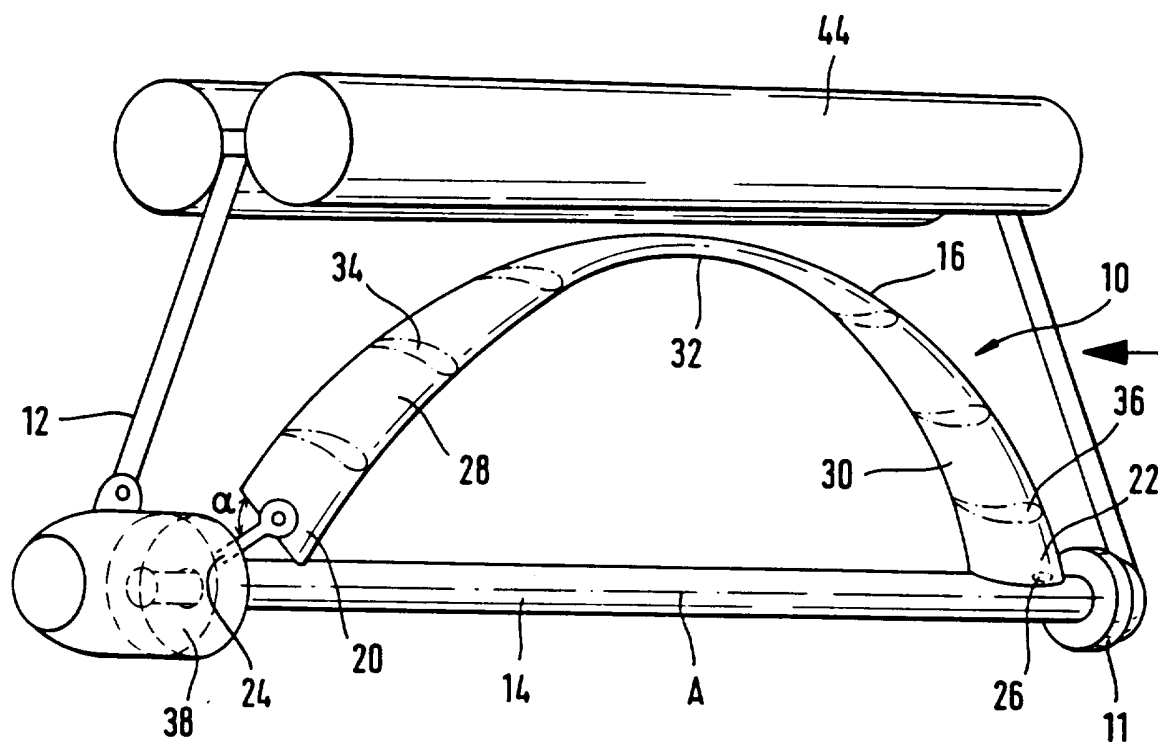
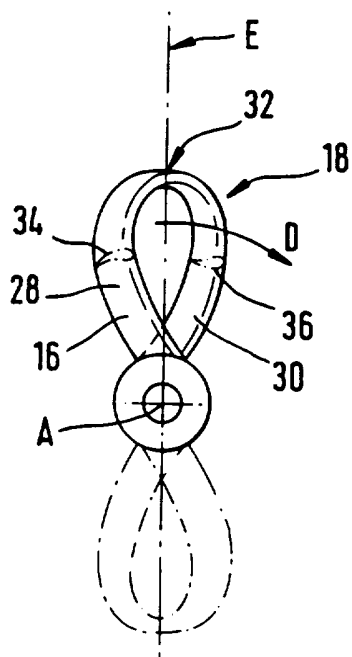


Fig. 1

Fig. 2



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Fig. 3

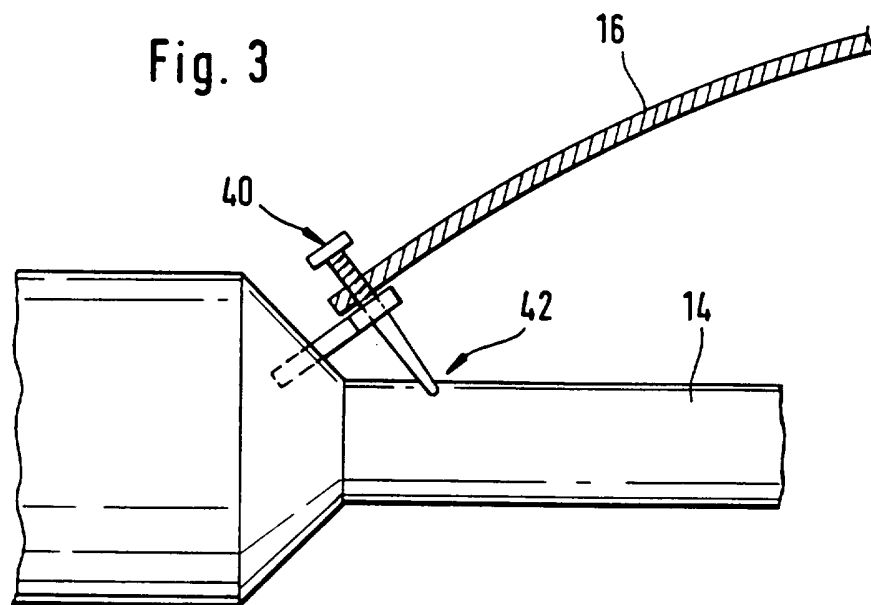
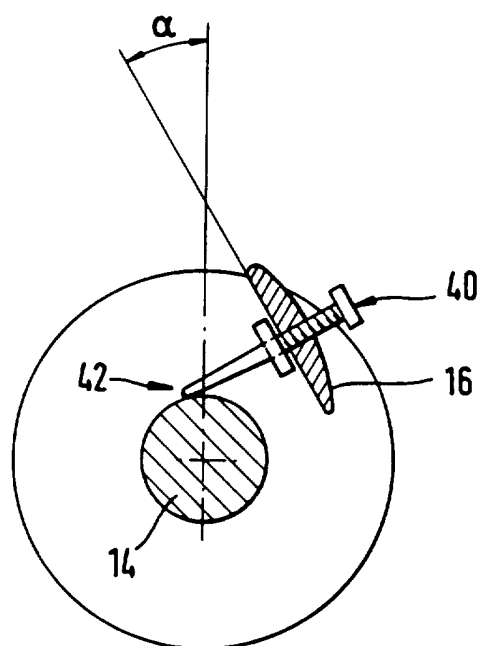


Fig. 4



INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 95/03450

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F03D1/06 F03B17/06

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

B. FIELDS SEARCHED

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IPC 6 F03D F03B

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR,A,2 609 506 (LEPOIX, L.) 15 July 1988 see the whole document see page 1, line 16 - line 20 see page 2, line 10 - line 15 see page 2, line 30 - line 38 see page 3, line 11 - line 25 see page 4, line 19 - line 33	1-10, 13-16
Y	---	11,12,17
Y	FR,A,2 569 243 (AUBERTIN, E.) 21 February 1986 see page 10, line 5 - line 9; figure 6 ---	11,12
Y	US,A,4 270 056 (WRIGHT, O.) 26 May 1981 see column 3, line 37 - line 46; figures 1,2 ---	17
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,A,39 19 157 (ZILLNER, G.) 21 December 1989 see column 7, line 40 - line 52; figure 8 ---	1
A	DE,A,29 48 060 (ERNO RAUMFAHRTTECHNIK GMBH) 4 June 1981 see figure 1 ---	1
A	DE,A,29 50 572 (WENZ, H.) 19 June 1981 see figures -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. Application No

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DE-A-2950572	19-06-81	NONE	