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(54) **Micro-power generator suitable for an electronic device, electronic device comprising such a micro-power generator**

(57) Micro-power generator suitable for a wearable, portable or moving electronic device, comprising:
- a rotor wheel comprising a multipole magnetic array, preferably a multipole magnetic ring or disc,
- at least one stator which is a multipole metal stator comprising at least one stator coil having a plurality of windings for producing an electric voltage,
- a base plate onto which the rotor wheel and the stator are mounted, wherein:
the at least one stator is fixedly connected to the base plate, the rotor wheel is pivotally connected to the base plate by a pivoting mechanism which allows for a rotation of the rotor wheel about a pivot axis perpendicular to a first plane in which the rotor wheel extends, which pivot axis preferably has a concentric orientation to the rotor wheel,
and wherein the rotor wheel has a centre of mass that has an eccentric position with respect to the pivot axis.

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Micro-power generator suitable for an electronic device, electronic device comprising such a micro-power generator

The present invention relates in a first aspect to a micro-power generator suitable for a wearable, portable or moving electronic device, and in a second aspect to a micro-power generator comprising a multitude of stators. Furthermore, in a third aspect the invention relates to an electronic device that comprises such a micro-power generator, in a fourth aspect to the use of such an electronic device in combination with a location tracking device and in a fifth aspect to suitable assemblies of such an electronic device with a location tracking device.

The application of a micro-power generator for providing electricity to a wearable, portable or moving device, is well known in the relevant field of technology and has been notably evolving over the last decades.

Specific devices for which the micro-power generator has been proven suitable are watches, in particular smartwatches, wearable sensors and sensors on moving objects. Dependent on the specific device for which it is used, a micro-power generator is able to produce a power output in the range of several microwatt up to 10 Watt.

The main feature of the micro-power generator is that a pivotable rotor wheel comprising a magnetic ring is brought in rotation in concentric orientation to a stationary stator which comprises a stator coil with a plurality of windings. In the windings of the stator coil an electric voltage is produced based on the laws of electromagnetic induction, and the generator consequently forms a source of electric power. The size of the generator, its electromagnetic properties, the number of poles of the magnetic ring, the number of poles of the stator and the number of windings of the stator coil determine the amount of electrical voltage and power that can be produced.

In a commonly applied micro-power generator that is known from the art, the rotor wheel is driven over a set of transmission gears that is driven by the pivotal movement of an eccentric weight that is pivotally connected to a base plate or other

type of fixed body. The pivotal movement of the eccentric weight is herein accelerated via the set of transmission gears by a factor 40, such that the rotor wheel is rotating at a considerably higher speed. Such a micro-power generator is able to produce a useful voltage for micro-power applications, while both the rotor wheel and the stator can be kept of relatively small dimensions.

The kinetic energy that puts the eccentric weight in motion, stems from the movements that the micro-power generator as a whole makes while being in motion, such as during its use as part of a wearable or portable device.

Although useful in many respects, the known micro-power generator suffers from several disadvantages due to the following aspects:

- a significant loss of power output is observed due to an intrinsic frictional loss of kinetic energy over the transmission gears, both at low speeds of movement and in particular at high speeds of movement;
- to comply with reliability requirements of the gear transmission, additional mechanical rectifiers are needed as well as shock absorbing means which complicate the construction of the micro-power generator as a whole and further increase the frictional losses and therefore reduce the efficiency and power output of the micro-power generator;
- the limited size of the rotor and stator cause significant electromagnetic losses at higher speeds, reducing the electromagnetic efficiency and therefore reducing and limiting the power output at lower speeds and reducing and limiting the intended increase of power output at higher speeds;
- the accelerating gears and numerous mechanical components lead to significant noise and wear during power generation;
- the production of the generator is generally cumbersome and costly in view of all components needed.

It is therefore an object of the invention to develop a micro-power generator wherein the above disadvantages related to the known generator do no longer exist or are at least significantly reduced.

The above object of the invention is achieved, according to a first aspect of the invention, by the provision of:

a micro-power generator suitable for a wearable, portable or moving electronic device, comprising:

- a rotor wheel comprising a multipole magnetic array, preferably a multipole magnetic ring or disc,
- at least one stator which is a multipole metal stator comprising at least one stator coil having a plurality of windings for producing an electric voltage,
- a base plate onto which the rotor wheel and the stator are mounted, wherein:

the at least one stator is fixedly connected to the base plate,

the rotor wheel is pivotally connected to the base plate by a pivoting mechanism which allows for a rotation of the rotor wheel about a pivot axis perpendicular to a first plane in which the rotor wheel extends, which pivot axis preferably has a concentric orientation to the rotor wheel,

wherein the rotor wheel has a centre of mass that has an eccentric position with respect to the pivot axis.

As the rotor wheel according to the invention is provided with an eccentric centre of mass and comprises a magnetic array, it enables the use of a larger rotor and stator then currently feasible in a micro-power generator according the prior art, while it requires no gear transmission nor any additional mechanical components or any torsion springs which are needed in a micro-power generator according to the prior art. Hence, the micro-power generator according to the invention is typically a gearless micro-power generator, also referred to as a direct-drive micro-power generator. Consequently, the invention achieves less frictional loss of kinetic energy, a raised efficiency of electric power produced, a lower risk of malfunctioning of the micro-power generator and reduced noise and wear. Furthermore, the invention allows for an easy, preferably completely axial, assembly and lower costs of production of the micro-power generator.

Within the context of the invention, the pivot axis should be construed as a virtual axis which defines the rotation of the rotor wheel.

The multipole magnetic array may be part of, assembled to, or attached to the rotor wheel and may be formed by individual magnet segments or one or more multipole magnetic rings or alternatively by one or more multipole magnetic discs.

Furthermore, a stator may comprise one or more individual stator parts and the micro power generator may comprise one or more multipole stators, preferably axially and concentrically stacked.

Furthermore, a stator comprises one or more stator coils having a plurality of windings for producing an electric voltage.

Finally, within the context of the invention, the base plate may be any type of body or structural element suitable for supporting both the stator and rotor.

Preferably, in the micro-power generator according to the invention, the stator has an annular shape which is delimited by an inner radius r1 and an outer radius r2.

As such, the stator has an advantageous shape to electromagnetically interact with the rotor wheel, in particular with a multipole magnetic ring or disc.

It is furthermore preferred that the multipole magnetic ring or disc and the stator of annular shape are mounted in a concentric position to each other and to the pivot axis.

In the micro-power generator according to the invention, it is particularly preferred that the multipole magnetic ring or disc and the stator of annular shape are mounted coplanar with each other in the first plane, wherein:

- an inner radius r3 of the multipole magnetic ring or disc is larger than the outer radius r2 of the stator, so that the magnet rotates outside of the stator,
- or the inner radius r1 of the stator is larger than an outer radius r4 of the multipole magnetic ring or disc, so that the magnet rotates inside the stator.

As an alternative to the above preference, the multipole magnetic ring or disc and the stator of annular shape may be mounted parallel to each other wherein the stator extends in a plane that is different from the first plane. In such a case, the magnetic ring or disc and/or the stator may have an inner and/or outer radius of a comparable value. In this case the magnet rotates axially above or below the stator.

It is preferred in the micro-power generator according to the invention, that the pivoting mechanism is connected to the base plate and comprises a friction reducing support element, which support element is provided within an inner radius r3 of the multipole magnetic ring or disc or outside of an outer radius r4 of the multipole magnetic ring or disc, wherein preferably the support element is a bearing, more particular a sliding bearing or a ball bearing.

When the support element is constructed as a ball bearing, there are two main possible configurations applicable:

i) when provided within the inner radius of the multipole magnetic ring disc and preferably also within the stator, the ball bearing may comprise an inner race fixedly connected to the base plate and an outer race fixedly connected to the rotor wheel. For instance, a central shaft which is provided with an inner race may be fixedly connected to the base plate, while the outer race is fixedly connected to the rotor wheel;

ii) when provided outside of the outer radius of the stator, preferably outside the outer radius of the multipole magnetic ring or disc, the ball bearing may comprise an outer race fixedly connected to the base plate and an inner race fixedly connected to the rotor wheel.

The use of the support element achieves a minimization of frictional loss of kinetic energy of the rotor wheel and a consequent maximization of the electric power produced by the generator.

As a practical preference, the pivoting mechanism of the micro-power generator according to invention comprises a central shaft which coincides with the pivot axis.

For instance is the central shaft at one end rotatably mounted onto the base plate and at another end fixedly connected to the rotor wheel. Conversely, the central shaft may at one end be fixedly mounted onto the base plate and at another end rotatably connected to the rotor wheel, e.g. by a ball bearing.

In an effective, and therefore preferred embodiment of the micro-power generator according to the invention, the centre of mass of the rotor wheel has a distance dcm, measured from the pivot axis and in a plane perpendicular to the pivot axis, which is, considering the dimensional and mass constraints of the micro power generator, preferably equal to or larger than r3, preferably equal to or larger than (r3 + r4)/2, and most preferably equal to or larger than r4.

In general, the larger the distance dcm, the further the eccentric position of the centre of mass from the pivot axis, and hence the larger the amount of kinetic energy that will be harvested by the rotor wheel from the movements of the generator as a whole while being in motion.

When the micro-power generator as a whole should have relatively compact dimensions for its intended application, it is further preferred that the distance dcm is limited to a maximum value of 1.5 times r4 up to 2.0 times r4.

It is further preferred in the micro-power generator according to the invention, that the rotor wheel comprises a body of mass that is fixedly connected to the multipole magnetic ring or disc.

The body of mass may for instance be fixated onto the rotor wheel by a screw connection, by riveting, by (ultrasonic) welding, by a clamping connection or by gluing. Alternatively, the body of mass may be an integral part of the multipole magnetic ring or disc.

The body of mass determines for a major part the eccentric position of the centre of mass of the rotor wheel as a whole, this effect being dependent on the specific shape of the body of mass and its position onto the multipole magnetic ring or disc.

The centre of mass of the body of mass itself when mounted on the rotor wheel, has a distance dcm measured from the pivot axis and in a plane perpendicular to the pivot axis, which distance dcm has a value that falls in the same ranges as set out above for the centre of mass of the rotor wheel.

In the micro-power generator according to the invention, the body of mass is preferably made from a metal having a relatively high density, and preferably has a relatively high resistance to corrosion, such as Tungsten, brass and stainless steel.

A suitably high density range for the body of mass lies in the range of 6,000 to 20,000 kg/m3.

It is furthermore preferred in the micro-power generator according to the invention, that the body of mass has a weight ratio to the multipole magnetic ring or disc which is at least 1, preferably at least 2, and more preferably at least 4.

As such, the body of mass determines for the largest part the eccentric position of the centre of mass of the rotor wheel as a whole.

In practice, typically a weight ratio in the range of 3 up to 10 is most useful, although even higher ratios may be encompassed by the invention.

In the micro-power generator comprising a body of mass as set out above, it is preferred that the body of mass comprises a ring sector defined as an angular section of a ring that is in a concentric position to the multipole magnetic ring or disc, wherein the ring sector has an inner radius r5 and an outer radius r6, wherein r5 is equal to or larger than r4, and wherein the size of the angular section is determined by an angle theta which lies in the range of 90° and 360°, preferably of 100° and 180°, more preferably of 120° and 170°.

Such a size and shape of the ring sector assures an optimum efficiency of harvesting kinetic energy from the motion of the generator as a whole, and transforming this energy in rotational energy for the rotor wheel. Preferably the ring sector is made from a metal having a relatively high density, and preferably has a relatively high resistance to corrosion, such as Tungsten, brass and stainless steel. Other parts of the body of mass may be made from a more light weight material if practical feasible.

For practical reasons, it is an additional preference in the context of the invention that r6 is not larger than 2.0 times r4 up to 2.5 times r4. In that way, the micro-power generator as a whole has relatively compact dimensions in view of the intended use of the generator.

It is in addition preferred in the micro-power generator according to the invention, that the ring sector is connected to the pivoting mechanism by a substantially planar body which comprises either:

- a mounting bracket that is attached, preferably releasably attached, onto the ring sector; or
- a disc portion that is attached, preferably fixedly attached, to the ring sector, wherein the disc portion is an angular section of a disc that is in a concentric position to the ring sector.

The planar body is especially useful for connecting the ring sector to a pivoting mechanism which comprises a central shaft which coincides with the pivot axis.

Preferably the planar body, in particular when in the form of a mounting bracket, is made of a of a material that has a relatively low weight in comparison to the weight of the ring sector. As such the ring sector contributes for the largest part to the eccentricity of the centre of mass of the rotor wheel.

Additionally, the mounting bracket may be designed such that it has in itself an asymmetric distribution of mass that further contributes to the eccentricity of the centre of mass of the rotor wheel.

When the planar body is in the form of a disc portion, it is preferred that its size in terms of the angular section of the disc is determined by an angle theta which lies in the range of 90° and 360°, preferably of 100° and 180°, more preferably of 120° and 170°. The radius of the disc portion is preferably not larger than r6, and more preferably not larger than r5.

The disc portion may be made from a the same material as the ring sector that is attached to it, preferably a relatively high density material: as such the ring sector and the disc portion can be produced as one single piece made from one material.

The mounting bracket or disc portion is preferably provided on an upper side of the generator which side is opposite to a bottom side of the generator where the base plate or other type of fixed housing is positioned.

In respect of the size of the micro-power generator according to the invention, it is preferred that the generator has a height of 2 up to 25 mm, and that the rotor wheel has a diameter of 20 up to 100 mm, preferably 20 up to 35 mm.

Any generator has a general characteristic which is referred to as cogging torque, which is a an intrinsic effect that results from the interaction between the metal stator and the magnetic rotor and affects the transformation of kinetic energy into electrical energy of the micro power generator. The cogging torque of a generator is primarily dependent of the electromagnetic properties and design of the stator and rotor.

In the view of the desired cogging torque of the generator according to the present invention it is preferred that the cogging torque of the generator, including additional friction losses, is lower than the maximum static torque of the rotor wheel, which is at 90 degrees and in a vertical position of the micro power generator. More specific the cogging torque, including additional friction losses, is equal to the torque of the rotor wheel between 30 to 60 degrees in a vertical position of the micro power generator. These angles are also known as the cogging torque angle.

By pre-defining the cogging torque in the above manner, the drop angle of the rotor wheel in vertical position can be set, enabling an increase of generated energy at slow rotations of the micro-power generator because potential energy is stored into the eccentric weight of the rotor wheel and released to the stator when

the rotor wheel drops, also referred to as a weight drop. The weight drop occurs when the rotor wheel rotational angle relatively to the base plate exceeds the cogging torque angle as described above. In this way a low rotational speed of the micro-power generator can result in multiple drops of the rotor wheel at higher speed, generating a higher voltage and a more efficient power generation.

To assure significant power generation at low speeds of the rotor wheel the further following properties of the stator and multipole magnetic ring or disc are preferred:

In the micro-power generator according to the invention, the multipole magnetic array, preferably a multipole magnet ring or disc, preferably comprises 4 up to 100 magnetic poles, in particular 10 up to 60 magnetic poles.

It is noted that the individual poles in a multipole magnetic ring or disc are commonly arranged in respective adjacent segments along the arc of the multipole magnetic ring or disc.

In the micro-power generator according to the invention, the stator coil is preferably surrounded by an electromagnetic enclosure which interacts with the electromagnetic field of the rotor wheel in order to promote an induction effect in the windings of the stator coil, or multiple stator coils.

The electromagnetic enclosure is typically formed by a multitude of adjacent electromagnetic strips that surround respective adjacent parts of the stator coil. These strips are also referred to in the art as stator legs, and are electrically isolated from the windings of the stator coil.

It is further preferred that the electromagnetic enclosure extends over the complete stator coil. Typically a number of 4 up to 100, in particular 10 to 60, adjacent strips are used to construct an effective electromagnetic enclosure for the stator coil.

Effectively, the electromagnetic enclosure as such accomplishes that the stator as a whole functions as a multipole metal stator.

It is further preferred in the micro-power generator according to the invention that a first end and an opposed second end of the stator coil or stator coils are electrically connectable to an electrical circuit of a device for which the micro-power generator is suitable.

In case of multiple stator coils the first and second end of each coil can be linked to the electric circuit and/or the multiple coils can be linked together in parallel or in series before being connected to the electric circuit.

As such a micro-power generator is rendered which can directly be used for its intended purpose of generating energy and signals. The micro-power generator produces the following signals: voltage, current and frequency. The signals allow to deduce the rotational speed, acceleration and (incremental) rotational angle of the rotor wheel. The signals and the inducted information can subsequently be used by an electronic device connected to the micro-power generator.

In a special second aspect, the invention relates to a micro-power generator comprising at least two stators according to the invention, wherein one stator produces a signal having a shifted phase with respect to the signal of another stator.

Such a system allows, besides deduction of speed, acceleration and (incremental) rotational angle, to deduce also the rotation direction – clockwise or counter-clockwise - of the rotor wheel that has been set in motion, from the different signals generated according to the phase difference between the two signals. The signals and the deducted information can subsequently be used by an electronic device connected to the micro-power generator.

A third aspect of the invention relates to a device, such as a watch, in particular a smartwatch, a wearable sensor or a sensor on moving objects, which device comprises a micro-power generator according to the first or second aspect of the invention, which is electrically connected to an electrical circuit of the device.

As such, a device is rendered which can be directly used for its intended purpose. The power output from the micro-power generator powers the electronic device to reduce or eliminate the replacement or recharging of batteries and preferably totally eliminate the use of batteries.

In the device, the micro-power generator produces at least the following signals: voltage, current and frequency. These signals vary during use of the device as a result of the motion of the object to which the device is attached and the related rotation of the rotor wheel of the micro-power generator.

In the device according to the third aspect of the invention, it is accordingly preferred that the varying signals that the micro-power generator produces, are used, directly or indirectly, by the electronic circuit of the device, preferably in determining the movement of the rotor wheel of the micro-power generator, the micro-power generator and/or the motion of the device and/or the object to which it is attached.

During the use of a device which is connected to a moving object, the varying values of the signals of the micro-power generator can be used to derive the movement of the micro-power generator and the motion of the device and/or the object to which the device is attached. It is in this context advantageous that the device additionally produces specific signals that are related to the rotational speed, acceleration, (incremental) rotational angle and/or rotational direction of the rotor wheel of the micro-power generator and the related movement of the micro-power generator, the device and/or the object to which the device is attached.

Therefore, a preferred embodiment of the device according to the invention, comprises a device,

- wherein the micro-power generator is configured to produce at least one signal related to the movement of the rotor wheel,
- and wherein the electrical circuit of the device is powered by the micro-power generator
- and wherein the electrical circuit comprises a processor that is configured to, directly or indirectly, receive the at least one signal produced by the micro-power generator and uses the signal, preferably for creating functions within the device and/or preferably to transform the signal into an output signal representative for the movement of the rotor wheel of the micro-power generator and/or the related motion of the device and/or the object to which the device is attached.

The signals produced by the micro-power generator relating to its output, may require additional signal producing elements in the form of electric switches, reed contacts, hall sensors, etc.. These elements may be added to the micro-power generator, in particular to its pivoting or moving parts.

The characteristics of the signals produced by the generator may vary with the rotational speed, the acceleration, the rotational direction, the position, and/or the incremental position of the rotor wheel with respect to the base plate.

For example, the signals of the micro-power generator can be used by the processor to activate the electronic circuit from deep sleep mode when motion is present, in order to reduce power consumption when no energy is being generated. Another example is that the signals may be used by the processor to describe the motion of the object to which the micro-power generator is attached and more specific may describe the activity, (rotational)speed, (rotational)direction, acceleration, travelled distance, revolutions turned, (incremental)position of the object. This information might be used for functionality of the electronics or the device, they might be stored and/or transmitted. An more detailed example is that the device is attached to a wheel and based on the rotation of the wheel and subsequently the signals created by the device due to the rotation of the rotor wheel of the micro power generator the device wakes up when the wheel starts moving, is activated to send a output signal every 10 revolutions and calculates based on the signals the horizontal speed and travelled distance of the wheel.

The electrical circuit of the device may further comprise:

- a rectifier for rectifying the voltage from AC to DC, a capacitor or rechargeable battery for storage of the energy, a microprocessor for power management and programming of the functionality of the product, a wireless transmitter and other components required for the overall product functionality.

Further preferred in the device according to the invention, is that the processor produces an output signal which is representative for the activity, (rotational)speed, (rotational)direction, acceleration, travelled distance, revolutions turned, (incremental)position of the device or the (living) object to which the device is attached.

In another preferred embodiment of the device according to the invention, the device comprises a preprogramed signal processor, in which preferably at least one cross-reference between at least one signal related characteristic and at least one output signal related characteristic are stored, wherein the processor is configured to transform at least one signal into at least one output signal by making use of said preprogramed signal processor.

A fourth aspect of the invention, is related to the use of a device according to the third aspect of the invention, in combination with a location tracking device, for example a GPS or Wifi, Bluetooth or cellular tracking system, to generate combined data of both devices.

In addition, it is advantageous when such use further encompasses the provision of the combined data in a presentable format to be monitored by a user of the signal producing device, or by a remote supervisor.

A fifth aspect of the invention is related to an assembly of a device according to the third aspect of the invention and a location tracking device, which assembly is configured to generate combined data from both devices.

As a preferred embodiment, the assembly is a wearable device for humans or animals, or a device that is mountable onto a moving object, such as a wheel of a moving object.

Examples and drawings

The invention will be further illustrated by the appended drawings of several non-limitative examples of a micro-power generator according to the invention.

In the appended drawings:

Fig. 1A shows a top view of a first preferred embodiment of the invention;

Fig. 1B shows a cross-sectional view of the first preferred embodiment of the invention;

Fig. 2A shows a top view of a second preferred embodiment of the invention;

Fig. 2B shows a cross-sectional view of the second preferred embodiment of the invention;

Fig. 3A shows a perspective view of a third preferred embodiment of the invention; and

Fig. 3B shows a cross-sectional view of the third preferred embodiment of the invention.

Figure 1A shows a top view of a micro-power generator 1 which is attached to a strap bracket 2 which is useful when the generator 1 forms an integral part of a wearable or portable device which is to be strapped to a user's wrist, an animal's neck, or to a part of a moving object.

The generator 1 is composed of a multipole magnetic ring 4 having an inner radius r3 and an outer radius r4, and a stator 6 of an annular shape which is delimited by an inner radius r1 and an outer radius r2. The radii r1, r2, r3 and r4 are defined with respect to centre point c of the generator.

The individual poles on the multipole magnetic ring 4 are arranged as alternating adjacent segments 5, 5'. The total number of individual poles is 40. The stator 6 contains 40 poles and the stator 6 contains a stator coil 7, of which the total number is 1460.

The stator 6 and multipole magnetic ring 4 are concentrically positioned to each other with respect to centre c, and substantially in coplanar orientation with each other. The stator is fixedly connected to an underlying base plate 10, of which a central part is visible.

The multipole magnetic ring 4 is fixedly connected to a body of mass 12 which together form the rotor wheel 14. The rotor wheel 14 is pivotally connected to the base plate 10 by a pivoting mechanism in the form of a ball bearing 16 which allows for a rotation of the rotor wheel about a pivot axis. The ball bearing 16 surrounds the outer radius r4 of the multipole magnetic ring 4. The pivot axis coincides with the centre c and has a perpendicular orientation to the plane in which the rotor wheel 14 and the stator 6 are present. Due to the body of mass 12, the rotor wheel 14 as a whole has a centre of mass at the location 20 indicated by an x in the figure. The centre of mass 20 has a distance to centre c, which is about the value of r2 or r3. As such, the centre of mass 20 has an eccentric position with respect to the centre point c and hence with the pivot axis.

The body of mass 12 has the form of a ring sector 12 defined as an angular section of a ring that is in concentric position to the multipole magnetic ring 4, wherein the ring sector has an inner radius r5 and an outer radius r6 and wherein the size of the angular section is determined by an angle theta between lines R and R' which is about 170°.

In figure 1B, the parts already described in respect of fig. 1A, are indicated by the same reference numerals.

Fig. 1B further shows the pivot axis p which intersects the centre point c of the generator, and the ball bearing 16 which contains an inner race 24 that is fixed onto the rotor wheel 14, and an outer race 22 which is fixed onto the base plate 10. The ring sector 12 includes a vertical part 26 which determines the height of the ring sector 12 and which part 26 extends over a same angular section as the ring sector 12.

Figure 2A shows a micro-power generator 1, which contains a multipole magnetic ring 4 and a stator 6, having similar properties as the multipole magnetic ring 4 and a stator 6 shown in fig. 1A, except where stated otherwise below.

A body of mass 27 includes on the upper side a disc portion that is fixedly attached to a ring sector (not visible, see fig. 2B) and to the multipole magnetic ring 4, which elements together form the rotor wheel 14. The disc portion is an angular section of a disc that has a concentric orientation to the stator 6. The size of the disc portion is determined by an angle theta between lines R and R' which is about 170°. Due to the body of mass 27, the rotor wheel 14 as a whole has a centre of mass at the location 20 indicated by an x in the figure. The centre of mass 20 of the rotor wheel thus has an eccentric position with respect to the centre point c and hence with the pivot axis.

The rotor wheel 14 is pivotally connected to the base plate (not visible, see fig. 2B) by a pivoting mechanism in the form of a ball bearing 16 which allows for a rotation of the rotor wheel about the pivot axis of the ball bearing 16. The ball bearing 16 is mounted within the inner radius r1 of the stator 6 and connected to the base plate by a central shaft (not visible).

In figure 2B, the parts already described in respect of fig. 2A, are indicated by the same reference numerals.

Fig. 2B further shows the body of mass 27 including a ring sector 28 which extends over a same angular section as the disc portion which forms the top part of the body of mass 27. Onto base plate 10 a central shaft 30 is fixedly connected which extends along the pivot axis p. On the outside of shaft 30 is a bearing 16 provided with an inner race fixedly connected to the shaft. The outer race of the bearing 16 is fixedly connected onto the body of mass 30.

Figure 3A shows a micro-power generator 1, which contains a multipole magnetic ring 4 and a stator 6, having similar properties as the multipole magnetic ring 4 and a stator 6 shown in fig. 1A, except where stated otherwise below.

A mounting bracket 40 is clamped by virtue of arms 42 onto both the multipole magnetic ring 4 and the ring sector 52 which assembled together form a rotor wheel 14. The ring sector 52 functions herein as a body of mass. The inner arms 44 are clamped onto an outer race 48 of a ball bearing which further comprises an inner race 50 that is fixed onto a central shaft 52 that is connected onto the base plate 10.

The ring sector 52 has the size of an angular section of a ring of about 120°. Due to the ring sector 52, the rotor wheel 14 as a whole has a centre of mass which has an eccentric position with respect to the pivot axis.

In figure 3B, the parts already described in respect of fig. 3A, are indicated by the same reference numerals.

Fig. 3B further shows the pivot axis p of the ball bearing 54; the central shaft 52 connected to the inner race 50 of the ball bearing, and the outer race of the ball bearing 48 connected to the clamping arms 44 of the mounting bracket 40. The central shaft 52 aligns and fixes both the rotor wheel (inner race 50 of ball bearing) and the stator 6 to the base plate base plate 10. The alignment is based on form fits of the central shaft 52, the stator 6 and the ball bearing inner race 50. The fixation is achieved by riveting the top and bottom end of the shaft. Other methods for fixation could be used like gluing, (laser) welding, screwing or bending.

It will be clear that the invention is not limited to the embodiment examples presented and described here, but that numerous variants are possible within the scope of the appended claims, which will be obvious to a person skilled in the art. It is conceivable that various inventive concepts and/or technical measures of the embodiment variants described above may be combined completely or partially without departing from the inventive concepts described in the appended claims.

The verb "comprise" and conjugations thereof used in this patent specification mean not only "comprise", but also the expressions "include", "consist essentially of", "formed by", and conjugations thereof.

Conclusies

1. Microvermogengenerator geschikt voor een aantrekbare, draagbare, of bewegende elektronische inrichting, omvattende:

- een rotorwiel omvattende een multipolige magnetische rij, bij voorkeur een multipolige magnetische ring of schijf,
- ten minste één stator welke een multipolige metalen stator is omvattende ten minste één statorspoel met een veelheid windingen voor het produceren van een elektrisch voltage,
- een basisplaat waarop het rotorwiel en de stator zijn gemonteerd,

waarbij:

de ten minste ene stator gefixeerd is verbonden met de basisplaat, het rotorwiel draaibaar is verbonden met de basisplaat door middel van een draaimechanisme dat een rotatie toestaat van het rotorwiel om een draaias die loodrecht staat op het vlak waarin het rotorwiel zich uitstrekt, waarbij de draaias bij voorkeur een concentrische oriëntatie heeft ten opzichte van het rotorwiel, en waarbij het rotorwiel een massamiddelpunt heeft dat een excentrische positie heeft ten opzichte van de draaias.

2. Microvermogengenerator volgens conclusie 1, waarbij de stator een ringvormig ontwerp heeft dat wordt ingesloten door een binnenstraal r1 en een buitenstraal r2.

3. Microvermogengenerator volgens conclusie 2, waarbij de multipolige magnetische ring of schijf en de stator met een ringvormig ontwerp, zijn gemonteerd in een concentrische positie ten opzichte van elkaar en de draaias.

4. Microvermogengenerator volgens conclusie 3, waarbij de multipolige magnetische ring of schijf en de stator met een ringvormig ontwerp, in een gemeenschappelijk vlak zijn gemonteerd ten opzichte van elkaar in het eerste vlak, waarbij:

- een binnenstraal r3 van de multipolige magnetische ring of schijf groter is dan de buitenstraal r2 van de stator,
- of de binnenstraal r1 van de stator groter is dan de buitenstraal r4 van de multipolige magnetische ring of schijf.

5. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij het draaimechanisme is verbonden met de basisplaat en een frictieverlagend draagelement omvat, welk draagelement is voorzien binnen een binnenstraal r3 van de multipolige magnetische ring of schijf en/of buiten een buitenstraal r4 van de multipolige magnetische ring of schijf waarbij bij voorkeur het draagelement een kogellager is.

6. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij het draaimechanisme een centrale schacht omvat welke samenvalt met de draaias.

7. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij het massamiddelpunt van het rotorwiel een afstand dcm heeft, gemeten vanaf de draaias en in een vlak loodrecht op de draaias, welke gelijk is aan of groter dan r3, bij voorkeur gelijk aan of groter dan (r3+r4)/2, en bij meeste voorkeur gelijk aan of groter dan r4.

8. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij het rotorwiel ten minste één massalichaam omvat dat gefixeerd is verbonden met de multipolige magnetische ring of schijf.

9. Microvermogengenerator volgens conclusie 8, waarbij het massalichaam gemaakt is van een metaal met relatief hoge dichtheid, en bij voorkeur een relatief hoge corrosiebestendigheid, zoals wolfraam, brons en roestvast staal.

10. Microvermogengenerator volgens conclusie 8 of 9, waarbij het massalichaam een gewichtsverhouding heeft ten opzichte van de multipolige magnetische ring of schijf, welke ten minste 1 is, bij voorkeur ten minste 2, en bij meeste voorkeur 4.

11. Microvermogengenerator volgens een van de conclusies 8 - 10, waarbij het massalichaam een ringsector omvat die is gedefinieerd als een hoeksectie van een ring welke een concentrische positie heeft met de multipolige magnetische ring of schijf, waarbij de ringsector een binnenstraal r5 en een buitenstraal r6 heeft,

waarbij r5 gelijk is of groter dan r4, en waarbij de omvang van de hoeksectie wordt bepaald door een hoek theta die in het gebied ligt van 80° en 200°, bij voorkeur 100° en 180°, en bij meer voorkeur 120° en 170°.

12. Microvermogengenerator volgens conclusie 11, waarbij de ringsector een hoogte heeft die gelijk is of groter dan de hoogte van de multipolige magnetische ring of schijf.

13. Microvermogengenerator volgens een van de conclusies 11 of 12, waarbij de ringsector verbonden is met een draaimechanisme door middel van een hoofdzakelijk vlak lichaam omvattende:

- een montagebeugel die losneembaar is verbonden aan de ringsector; of
- een schijfdeel dat gefixeerd is verbonden aan de ringsector, waarbij het schijfdeel een hoeksectie is van een schijf die een concentrische positie heeft ten opzichte van de ringsector.

14. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij de generator een hoogte heeft van 2 tot 25 mm, en het rotorwiel een diameter heeft van 20 tot 100 mm, bij voorkeur 20 tot 35 mm.

15. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij de multipolige magnetische rij bij voorkeur 4 tot 100 magnetische polen omvat, in het bijzonder 10 tot 60 magnetische polen.

16. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij de statorspoel is omgeven door een elektromagnetische omhulling die interacteert met het elektromagnetische veld van het rotorwiel teneinde een inductie-effect te verhogen in de windingen van de statorspoel.

17. Microvermogengenerator volgens één van de voorgaande conclusies, waarbij een eerste einde en een tegenoverliggend tweede einde van de statorspoel of statorspoelen, elektrisch verbindbaar zijn met een elektrische circuit van een inrichting waarvoor de Microvermogengenerator geschikt is.

18. Microvermogengenerator volgens één van de voorgaande conclusies, omvattende ten minste twee statoren, waarbij een stator een signaal produceert met een verschoven fase ten opzichte van het signaal van de andere stator.

19. Inrichting, zoals een horloge, in het bijzonder een slim horloge, een draagbare sensor of een sensor op bewegende objecten, waarbij de inrichting ten minste één Microvermogengenerator omvat volgens één van de voorgaande conclusies 1-18, welke elektrisch is verbonden met het elektrisch circuit van de inrichting.

20. Inrichting volgens conclusie 19,

- waarbij de Microvermogengenerator is ingericht om ten minste één signaal te produceren dat gerelateerd is aan de opbrengst van de generator,
- en waarbij het elektrisch circuit van de inrichting onder spanning wordt gebracht door de Microvermogengenerator,
- en waarbij het elektrisch circuit een processor omvat die is ingericht om al dan niet direct, ten minste één signaal te ontvangen dat is geproduceerd door de Microvermogengenerator en het signaal te gebruiken, bij voorkeur voor het creëren van functies binnen de inrichting en/of bij voorkeur het signaal te transformeren tot een opbrengstsignaal dat representatief is voor de beweging van het rotorwiel van de Microvermogengenerator en/of de gerelateerde beweging van de inrichting en/of het object waaraan de inrichting is bevestigd.

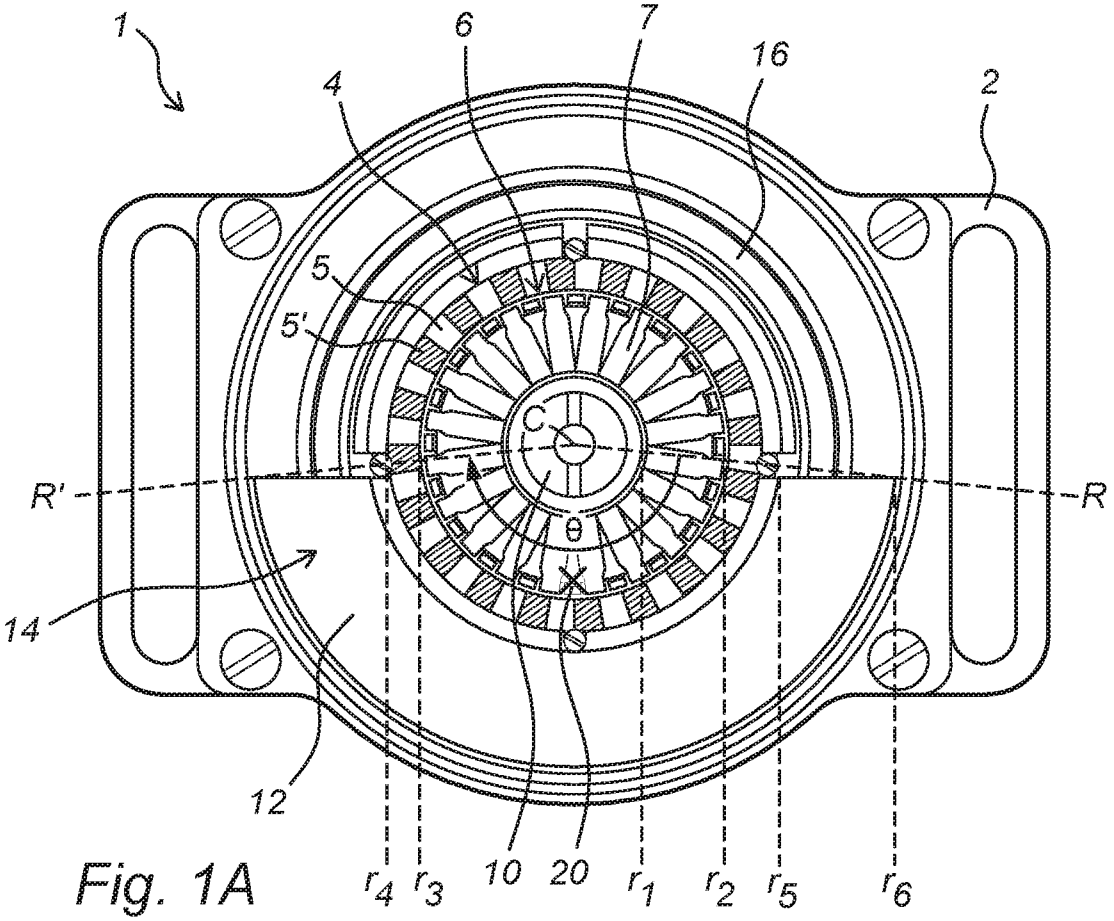
21. Inrichting volgens conclusie 20, waarbij de processor een opbrengstsignaal produceert dat representatief is voor de activiteit, (rotatie)snelheid, (rotatie)richting, versnelling, afgelegde afstand, aantal omwentelingen, (stapsgewijze) positie van de inrichting of het (levende) object waaraan de inrichting is vastgemaakt.

22. Inrichting volgens conclusie 20 of 21, welke een vooraf geprogrammeerde signaalprocessor omvat, waarin bij voorkeur ten minste één vergelijkingsreferentie is opgeslagen voor ten minste één signaal-gerelateerd kenmerk en ten minste één opbrengstsignaal-gerelateerd kenmerk, waarbij de processor is ingericht om ten minste één signaal te transformeren tot ten minste één opbrengstsignaal door gebruik te maken van de vooraf geprogrammeerde signaalprocessor.

23. Gebruik van een inrichting volgens één van de voorgaande conclusies 19-22, in combinatie met een locatie-tracerende inrichting, om gecombineerde gegevens te genereren van beide inrichtingen.

24. Samenstel van een inrichting volgens één van de voorgaande conclusies 19-22 en een locatie-tracerende inrichting, welk samenstel is ingericht om gecombineerde gegevens te genereren van beide inrichtingen.

25. Samenstel volgens conclusie 24, dat een draagbare inrichting is voor mensen of dieren, of een inrichting is die monteerbaar is op een bewegend object zoals een wiel van een bewegend object.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7
16
4
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5
5'
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14
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20
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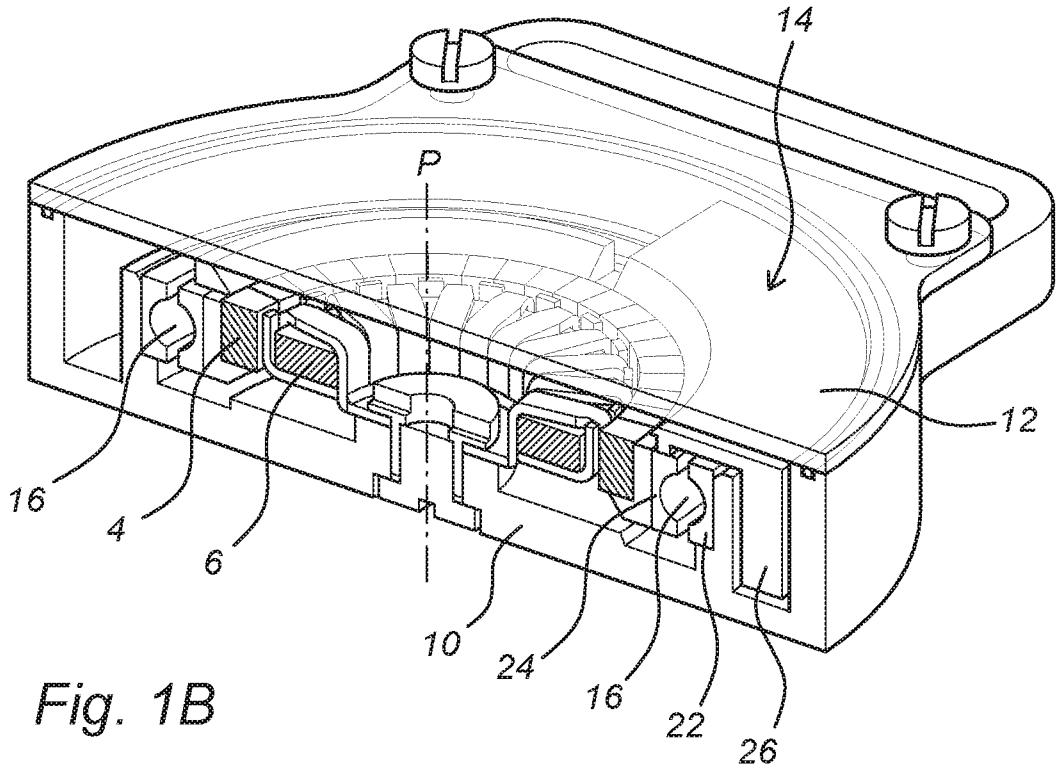
r_6

Fig. 1A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26

Fig. 1B

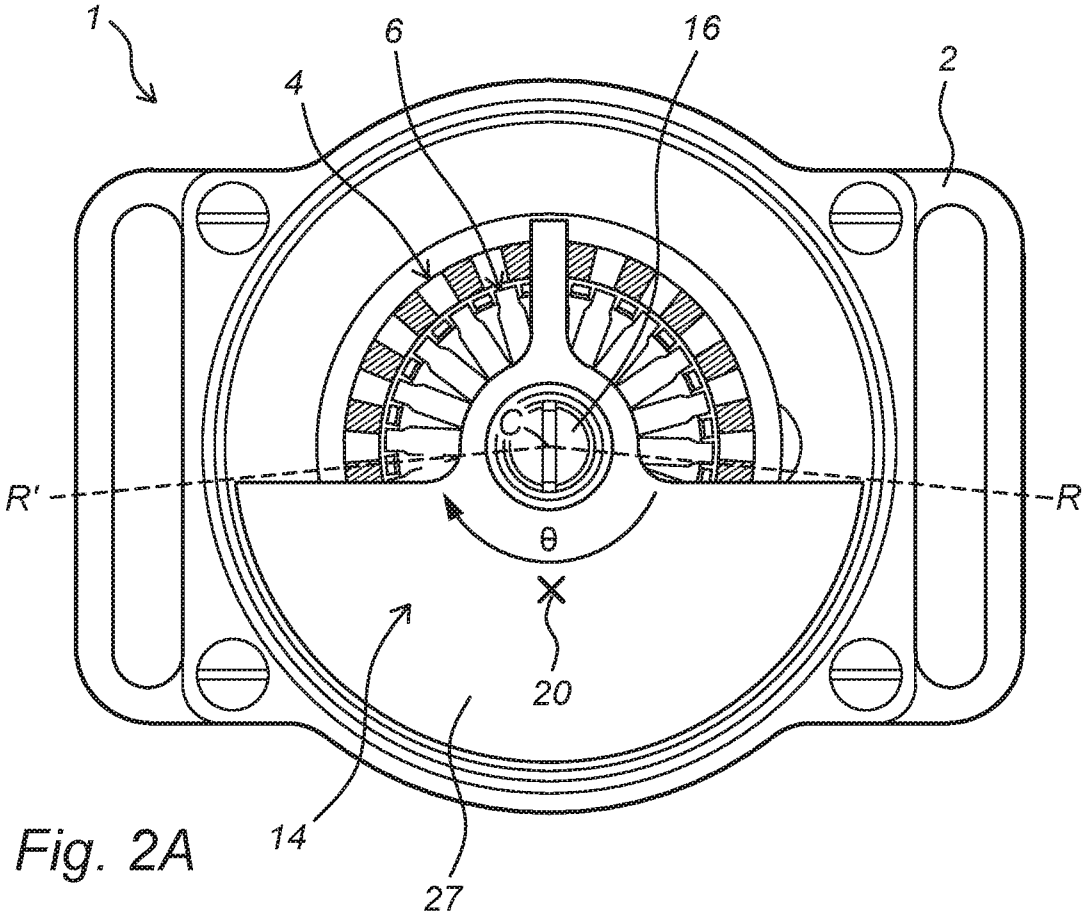

Fig. 2A

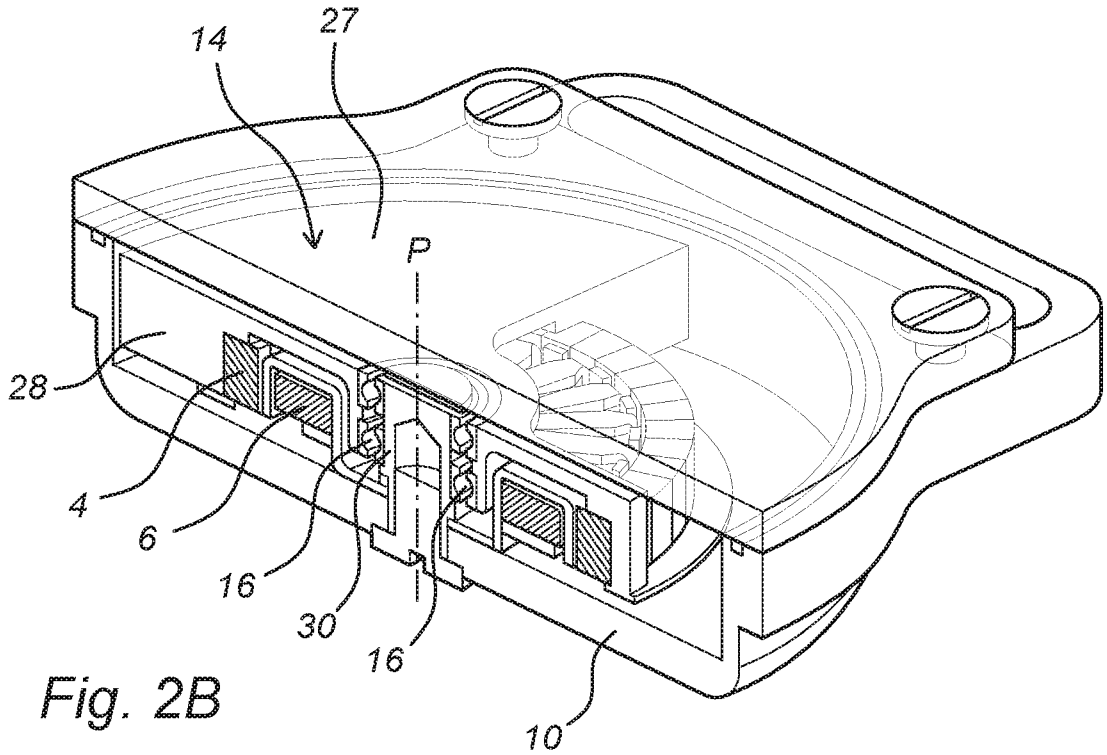

Fig. 2B

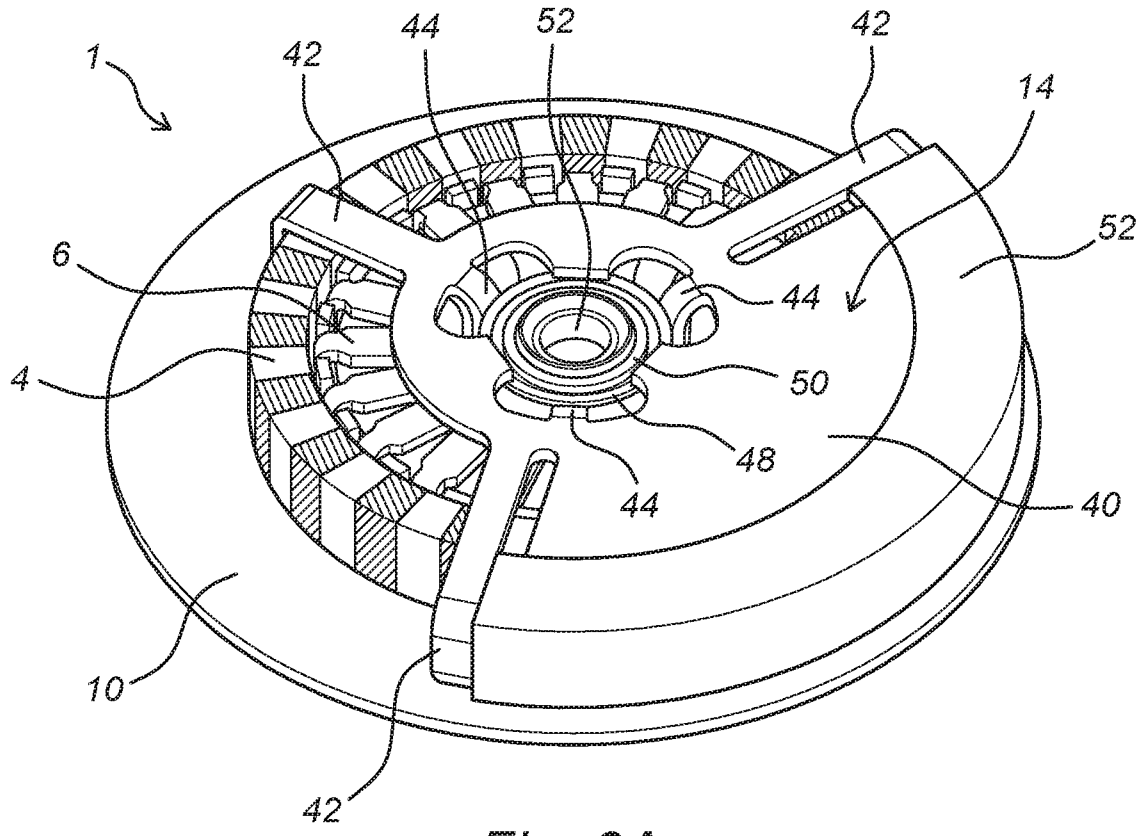
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Fig. 3A

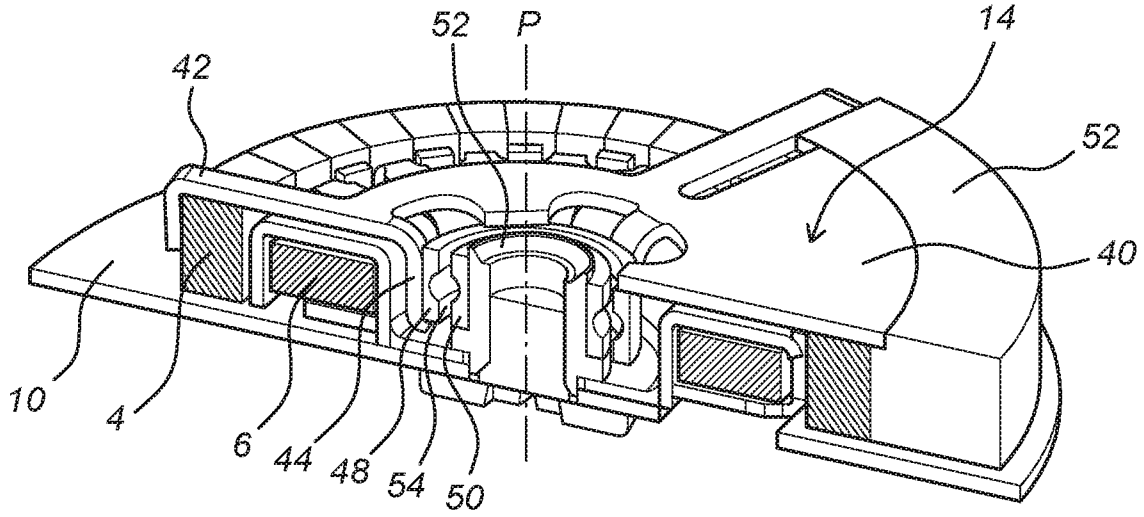
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Fig. 3B

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	1.1181.006 NL
Nederlands aanvraag nr. **2024644**	Indieningsdatum **10-01-2020**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **Kinetron B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **18-04-2020**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN76012**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

Zie onderzoeksrapport

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**Zie onderzoeksrapport**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐	**GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☒	**GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2024644

A. CLASSIFICATIE VAN HET ONDERWERP
INV. H02K35/02 H02K7/06 G04C10/00 G04G19/00
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
H02K G04G G04C

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
	EENHEID VAN UITVINDING ONTBREEKT zie aanvullingsblad B -----	
X	CN 2 932 820 Y (TAI ZHENGYONG [CN]) 8 augustus 2007 (2007-08-08) * samenvatting * * alinea [0008] - alinea [0011] * -----	1-6, 8-10,14, 15, 17-19, 23-25
X	EP 0 170 303 A1 (KINETRON BV [NL]) 5 februari 1986 (1986-02-05) * bladzijde 2, regel 8 - regel 17 * * bladzijde 3, regel 22 - bladzijde 4, regel 31; figuren 1, 2 * ----- -/--	1-16,19

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
22 september 2020	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Moyaerts, Laurent

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2024644

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	WO 84/01041 A1 (KNAPEN PETRUS MATHEUS JOSEPHUS) 15 maart 1984 (1984-03-15) * bladzijde 1, regel 1 - regel 9 * * bladzijde 3, regel 33 - bladzijde 4, regel 26; figuren 4-9 * -----	1-6, 8-15,18, 19

Formulier PCT/ISA/201 (vervolg tweede blad) (Januari 2004)

GEBREK AAN EENHEID VAN UITVINDING

Octrooiaanvrage Nr.:
SN 76012
NL 2024644

AANVULLINGSBLAD B

De Instantie belast met het uitvoeren van het onderzoek naar de stand van de techniek heeft vastgesteld dat deze aanvrage meerdere uitvindingen bevat, te weten:

1. conclusies: 1-19(compleet); 23-25(gedeeltelijk)

A micro-power generator for a wearable, portable or moving electronic device, its integration in such a device, in particular in combination with a location tracking device.

1.1. conclusies: 1-18

The micro-power generator characterized by features of the magnetic circuit.

1.2. conclusies: 19(compleet); 23-25(gedeeltelijk)

A wearable, portable or moving device comprising the micro-power generator, in particular in combination with a location tracking device.

---

2. conclusies: 20-22(compleet); 23-25(gedeeltelijk)

A wearable, portable or moving electronic device comprising a micro-power generator, in particular comprising a processor programmed to produce a signal representative for the movement of the electronic device, based on a signal of the micro-power generator.

Het vooronderzoek werd tot het eerste onderwerp beperkt.

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2024644

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
CN 2932820 Y	08-08-2007	GEEN	
EP 0170303 A1	05-02-1986	AT 40223 T	15-02-1989
		EP 0170303 A1	05-02-1986
		JP H0235547 B2	10-08-1990
		JP S6118326 A	27-01-1986
		KR 860001517 A	26-02-1986
		NL 8402113 A	03-02-1986
		US 4644246 A	17-02-1987
WO 8401041 A1	15-03-1984	EP 0119223 A1	26-09-1984
		NL 8203443 A	02-04-1984
		WO 8401041 A1	15-03-1984

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN76012	10.01.2020		NL2024644

International Patent Classification (IPC)
INV. H02K35/02 H02K7/06 G04C10/00 G04G19/00

Applicant
Kinetron B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☒ Box No. VIII Certain observations on the application

	Examiner
	Moyaerts, Laurent

Application number

WRITTEN OPINION

NL2024644

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step, or to be industrially applicable have not been examined in respect of

☐ the entire application

☒ claims Nos. 20-22(compleet); 23-25(gedeeltelijk)

because:

☐ the said application, or the said claims Nos. relate to the following subject matter which does not require a search *(specify)*:

☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed *(specify)*:

☒ no search report has been established for the whole application or for said claims Nos. 20-22(compleet); 23-25(gedeeltelijk)

☐ a meaningful opinion could not be formed as the sequence listing was either not available, or was not furnished in the international format (WIPO ST25).

☐ a meaningful opinion could not be formed without the tables related to the sequence listings; or such tables were not available in electronic form.

☐ See Supplemental Box for further details.

Box No. IV Lack of unity of invention

1. The requirement of unity of invention is not complied with for the following reasons:

   see separate sheet

2. This report has been established in respect of the following parts of the application:

   ☐ all parts.

   ☒ the parts relating to claims Nos. (see Search Report)

WRITTEN OPINION

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	9, 10, 14, 18
	No:	Claims	1-8, 11-13, 15-17, 19(compleet); 23-25(gedeeltelijk)
Inventive step	Yes:	Claims	
	No:	Claims	1-19(compleet); 23-25(gedeeltelijk)
Industrial applicability	Yes:	Claims	1-19(compleet); 23-25(gedeeltelijk)
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the application

see separate sheet

Box No. VIII Certain observations on the application

see separate sheet

Re Item IV

Lack of unity of invention

1 It is considered that there are several inventions covered by the claims.

The reasons, for which the inventions are not so linked as to form a single general inventive concept, are as follows.

2 The subject-matter of independent **claim 1** is already known (see the grounds for this objection). The requisite unity of invention therefore no longer exists inasmuch as a technical relationship involving one or more of the same or corresponding special technical features does not exist between the subject-matter of the following groups of dependent claims:

2.1 **Claims 2-18** define further technical features related to the design of the magnetic circuit of the micro-power generator.

They solve the technical problem of enhancing the efficiency of the power generator (see page 2, 2nd paragraph).

2.2 **Claim 19** addresses as technical feature the integration of the micro-power generator in a wearable, portable or moving electronic device and **claims 23-25** define a combination of the latter with a location tracing device.

This solves the problem of integrating the micro-power generator in a certain application.

2.3 **Claims 20-22** teach to provide a micro-processor in the wearable, portable or moving electronic device. This processor is programmed to produce a signal representative for the movement of the electronic device, based on a signal of the micro-power generator.

This addresses the technical problem of implementing functionalities of the wearable, portable or moving electronic device on the basis of the micro-power generator output.

2.4 The technical features representing the difference over the non-inventive common matter of each group of claims are not the same.

The objective technical problems underlying the subjects of the claimed groups of inventions are also different, so the special technical features of the different groups of inventions are not corresponding.

3 The claims are not linked by a technical relationship involving one or more same or corresponding special technical features, so the application lacks a single general inventive concept. Consequently the application does not meet the requirement for unity of invention.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 CN 2 932 820 Y (TAI ZHENGYONG [CN]) 8 augustus 2007 (2007-08-08)

D2 EP 0 170 303 A1 (KINETRON BV [NL]) 5 februari 1986 (1986-02-05)

D3 WO 84/01041 A1 (KNAPEN PETRUS MATHEUS JOSEPHUS) 15 maart 1984 (1984-03-15)

1 [**Claim 1**] The present application does not meet the criteria of patentability, because the subject-matter of claim 1 is not new:

1.1 D1 discloses

Microvermogengenerator (*par. [0003]: miniature generator*) geschikt voor een aantrekbare, draagbare, of bewegende elektronische inrichting (*Abstract: mobile phone, GPS position finder*), omvattende:
- een rotorwiel (*2*) omvattende een multipolige magnetische rij (*1*), bij voorkeur een multipolige magnetische ring of schijf,
- ten minste één stator (*3-4*) welke een multipolige metalen stator is omvattende ten minste één statorspoel (*3*) met een veelheid windingen (*figure 1*) voor het produceren van een elektrisch voltage,
- een basisplaat (*5*) waarop het rotorwiel (*2*) en de stator (*3-4*) zijn gemonteerd, waarbij:
de ten minste ene stator (*3-4*) gefixeerd (*via screw 9*) is verbonden met de basisplaat (*5*), het rotorwiel (*2*) draaibaar is verbonden met de basisplaat (*5*) door middel van een draaimechanisme (*bearing 13*) dat een rotatie toestaat van het rotorwiel (*2*) om een draaias die loodrecht staat op het vlak waarin het rotorwiel zich uitstrekt (*figure 2*), waarbij de draaias bij voorkeur een

concentrische oriëntatie heeft ten opzichte van het rotorwiel (*2*),en waarbij het rotorwiel (*2*) een massamiddelpunt heeft dat een excentrische positie heeft ten opzichte van de draaias (*via the eccentric balance wheel 7*).

1.2 D2 (*figures 1-2*) discloses

Microvermogengenerator geschikt voor een aantrekbare, draagbare, of bewegende elektronische inrichting (*An electric power supply system for portable miniature size power consuming devices*), omvattende:
- een rotorwiel omvattende een multipolige magnetische rij (*page 3, lines 26-28: "On the shaft 3 an assembly 5 comprising eight permanent magnets sectorially arranged over 360° is fixedly attached, thus forming a rotor wheel being rotatable in the stator construction 4"*), bij voorkeur een multipolige magnetische ring of schijf,
- ten minste één stator welke een multipolige metalen stator is omvattende ten minste één statorspoel (*6*) met een veelheid windingen (*page 4, line 24*) voor het produceren van een elektrisch voltage,
- een basisplaat (*4*) waarop het rotorwiel en de stator zijn gemonteerd (*see figure 2*), waarbij:
de ten minste ene stator gefixeerd is verbonden met de basisplaat (*4*), het rotorwiel draaibaar is verbonden met de basisplaat (*4*) door middel van een draaimechanisme dat een rotatie toestaat van het rotorwiel om een draaias die loodrecht staat op het vlak waarin het rotorwiel zich uitstrekt (*page 3, lines 25-26: "The shaft 3 is located centrally and is rotatable in a stator construction 4" & figure 2*), waarbij de draaias bij voorkeur een concentrische oriëntatie heeft ten opzichte van het rotorwiel (*figure 2*),en waarbij het rotorwiel een massamiddelpunt heeft dat een excentrische positie heeft ten opzichte van de draaias (*via the eccentric mass 1*).

1.3 D3 (*figures 4-9*) discloses

Microvermogengenerator geschikt voor een aantrekbare, draagbare, of bewegende elektronische inrichting (*a portable mini AC generator/DC accumulator for a mini power capacity as used e.g. for e wrist, a pocket or a necklace watch, a pacemaker or a battery powered hearing-aid*), omvattende:
- een rotorwiel (*20*) omvattende een multipolige magnetische rij (*19*), bij voorkeur een multipolige magnetische ring of schijf,
- ten minste één stator (*17*) welke een multipolige metalen stator is omvattende ten minste één statorspoel (*18*) met een veelheid windingen voor het produceren van een elektrisch voltage,
- een basisplaat (*figure 5*) waarop het rotorwiel (*20*) en de stator (*17*) zijn gemonteerd, waarbij:

de ten minste ene stator (*17*) gefixeerd is verbonden met de basisplaat, het rotorwiel (*20*) draaibaar is verbonden met de basisplaat door middel van een draaimechanisme dat een rotatie toestaat van het rotorwiel (*20*) om een draaias die loodrecht staat op het vlak waarin het rotorwiel zich uitstrekt (*figure 5*), waarbij de draaias bij voorkeur een concentrische oriëntatie heeft ten opzichte van het rotorwiel (*figures 4, 5*),en waarbij het rotorwiel (*20*) een massamiddelpunt heeft dat een excentrische positie heeft ten opzichte van de draaias (*This results from the arrangement of an eccentric mass as shown in figures 4-5; page 3, line 11 discloses further: "the mass inertia causing the rotor 11 to be out of balance"*).

2 **[Dependent claims]** The following dependent claims do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step:

2.1 **Claim 2**: D1 (*figure 2*); D2 (*figures 1-2*); D3 (*figures 4, 5*);

2.2 **Claim 3**: D1 (*figures 1, 2*); D2 (*figures 1-2*); D3 (*figures 4, 5*);

2.3 **Claim 4**: D1 (*figure 2*); D2 (*figures 1-2*); D3 (*figures 4, 5*);

2.4 **Claim 5**: D1 (*figure 2*); D2 (*draagelement = parts 10 & 16*); D3 (*shaft 21*);

2.5 **Claim 6**: D1 (*shaft core 10*); D2 (*shaft 3*); D3 (*shaft 21*);

2.6 **Claim 7**: In the configuration with inner rotor in D2, figures 1 and 2 and in view of the arrangement of the eccentric mass (*1*) on the radial outer side of the generator, the radius of the center of gravity of the rotor is at least equal or bigger than the outside radius of the magnetic arrangement (*5*).

2.7 **Claim 8**: D1 (*eccentric balance wheel 7*); D2 (*eccentric mass 1*); D3 (*figures 4, 5*);

2.8 **Claims 9, 10**: The choice of the material of the eccentric mass belongs to usual design measures which do not require inventive skills. Furthermore, the features proposed in the claims do not provide surprising effects which could justify an inventive step.

2.9 **Claim 11**: D2 discloses: waarbij het massalichaam (*1*) een ringsector omvat die is gedefinieerd als een hoeksectie van een ring (*circle sector*) welke een concentrische positie heeft met de multipolige magnetische ring of schijf (*figures 1, 2*), waarbij de ringsector een binnenstraal r5 en een buitenstraal r6 heeft, waarbij r5 gelijk is of groter dan r4 (*figure 2*), en waarbij de omvang van de

hoeksectie wordt bepaald door een hoek theta die in het gebied ligt van 80° en 200°, bij voorkeur 100° en 180° (*figure 1*); The features of claim 11 are also disclosed in D3, see figures 4-5.

2.10 **Claim 12**: D2 (*figure 2*); D3 (*figure 5*);

2.11 **Claim 13**: D2 discloses: waarbij de ringsector verbonden is met een draaimechanisme (*parts 10 & 16*) door middel van een hoofdzakelijk vlak lichaam (*plate 2*) omvattende:
- een schijfdeel (*plate 2*) dat gefixeerd is verbonden aan de ringsector, waarbij het schijfdeel een hoeksectie is van een schijf die een concentrische positie heeft ten opzichte van de ringsector (*figures 1, 2*). The features of the claim 13 are also disclosed in D3, see figures 4, 5.

2.12 **Claim 14**: The skilled person will design the generator according to the dimension of the product in which it shall be integrated and this design measure does not require inventive skills.

2.13 **Claim 15**: D1 (*par. [0011]: 12 magnets*); D2 (*the generator comprises 8 poles*); D3 (*page 4, line 10: "permanent magnets with at least 4 poles"*);

2.14 **Claim 16**: D2 (*page 3, lines 29-30: "a soft-iron yoke 7 enclosing the coil 6"*);

2.15 **Claim 17**: D1 (*rectifier circuit A, charging circuit B*);

2.16 **Claim 18**: Providing a second stator, in particular for redundancy reasons and/ or enhancing the plausibility of a signal output by the generator does not imply an inventive step.

2.17 **Claim 19**: D1 (*GPS position finder*); D2 (*a portable miniature size power consuming device*); D3 (*quartz watch*);

2.18 **Claim 24**: D1 (*GPS position finder*);

2.19 **Claim 25**: D1 (*Abstract: "The charger is not only capable of being attached on human body to generate power, but also applicable to onboard and horse back"*).

3 [**Claim 23**] D1 discloses, see the abstract: Gebruik van een inrichting volgens de conclusie 19, in combinatie met een locatie-tracerende inrichting (*GPS*), om gecombineerde gegevens te genereren van beide inrichtingen (*implicit by all GPS-based applications*).

Re Item VII

Certain defects in the application

1 The relevant background art disclosed in D1-D3 is not mentioned in the description, nor are these documents identified therein.

2 The features of the claims are not provided with reference signs placed in parentheses.

Re Item VIII

Certain observations on the application

1 **Claim 7** refers to *r3* and *r4* which are however not defined in claim 1.

2 The formulation "*relatief hoge dichtheid*" and "*relatief hoge corrosiebestendigheid*" used in **claim 9** has no well-recognized meaning and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear.

3 **Claim 11** refers to *r4* which is however not defined in claims 1 and 8.

4 **Claim 19** refers to an "*electric circuit*" in the definite form, however there is no such electric circuit defined in claim 1.