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[Continued on next page]

(54) **Title:** SELF-POWERED MOUSE EQUIPPED WITH MAGNETIC-MECHANICAL HARVESTER DEVICE FOR GENERATING ELECTRICITY

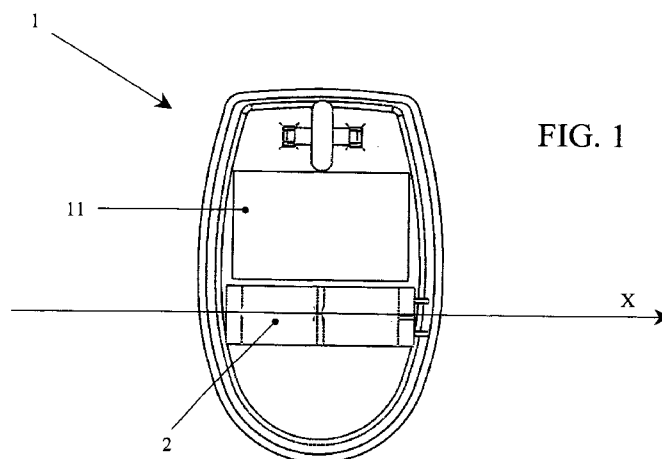


FIG. 1

(57) **Abstract:** A mouse (1) is described, comprising at least one magnetic-mechanical harvester device (2) for generating electric current supplying such mouse (1), such harvester device (2) comprising at least one mobile magnetic element (4) axially sliding along at least one translation axis A-A coaxial with at least one sliding guide (6); force optimizing elements (8) arranged in the side ends of such sliding guide (6) adapted to exert at least one force having an elastic and/or mechanical nature onto such mobile magnetic element (4), enabling a sliding of such mobile magnetic element (4) along such sliding guide (6); at least one first spiral-type winding (16), made of electrically conductive material, adapted to concatenate a magnetic flux created by such mobile magnet (4) and to develop an induced electromotive force when such flux changes in time due to the movement of such mobile magnetic element (4) along such sliding guide (6).



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SELF-POWERED MOUSE EQUIPPED WITH MAGNETIC-MECHANICAL
HARVESTER DEVICE FOR GENERATING ELECTRICITY

5

The present invention refers to a self-supplied mouse equipped with harvester device for
10 generating electricity.

Devices are known in the art, in different application environments, which are characterized by the use of "energy harvesting" technologies adapted to obtain the necessary energy for
15 operating the devices themselves directly from external sources (solar energy, thermal energy, kinetic energy from vibrations, etc.) present in the surrounding environment in which such devices operate, as disclosed, for example, in US5347186,
20 WO2011051800, TO2011A000843, TO2011A000844, TO2012A000527.

In particular, among the various energy sources which can be used, vibrations represent an innovative and advantageous energy source for
25 making harvester devices with inertial mass,

characterized by a rigid structure inside which there is a body partially free of moving, not integrally anchored to the rigid structure itself. The internal mass and the frame of these devices, 5 when they are subjected to mechanical stresses, move with a relative motion one with respect to the other, and this movement is useful for driving a transducer and obtaining a conversion from kinetic energy into electric energy.

10 Harvester devices are also known, which are capable of transforming the kinetic energy provided by vibrations into electric energy by exploiting different operating types depending on the frequency contents of vibrations themselves and 15 based, for example, on the piezoelectric principle, on the electrostatic principle (by using capacitors with plane parallel faces) or on the electromagnetic principle (exploiting electromagnetic induction phenomena).

20 In such specific technical field, US20020118173, KR100845814, TW201020866, CN101034325, CN102830820 disclose solutions which deal with self-supplied mouse. In particular:

- US20020118173 discloses a mechanical (ball) 25 mouse which uses a generator of the rotary

type coupled with the ball of the mouse itself to generate electric energy useful for supplying the device;

- 5 - KR100845814 discloses a wireless mouse equipped with three energy harvester devices, in which two are of the rotary type, and the third is a linear generator arranged vertically and composed of a magnet which can move inside a guide related to a fixed
10 winding;
- TW201020866 discloses a wireless optical mouse self-supplied through an electromagnetic rotary generator integral with the mouse ball: such generator is composed of two magnets
15 inserted in the ball and a coil inserted inside the support which bears the ball;
- CN101034325 discloses a wireless optical mouse integrating one or more energy generative devices of the rotary type;
- 20 - CN102830820 discloses a self-supplied mouse coupled with its related mouse-pad: in such device the generation of electric energy occurs through a relative motion between mouse and its related mouse-pad during the manual
25 use of the mouse itself.

The prior art however does not propose any mouse in which the electric generation for supplying the mouse itself occurs through an harvester device of the magnetic-mechanical type, in particular with horizontal arrangement of the harvester device inside the mouse.

Therefore, object of the present invention is solving the above prior art problems by providing a self-supplied mouse equipped with a magnetic-mechanical electric energy harvester device.

Another object of the present invention is providing a mouse equipped with an optimized harvester device with horizontal arrangement, in particular aligned with the X movement axis of the mouse itself.

The above and other objects and advantages of the present invention, as will result from the following description, are obtained with a self-supplied mouse equipped with magnetic-mechanical harvester device for generating electricity as claimed in Claim 1. Preferred embodiments and non-trivial variations of the present invention are the subject matter of the dependent claims.

It is intended that all enclosed claims are an integral part of the present description.

The present invention will be better described by some preferred embodiments thereof, provided as a non-limiting example, with reference to the enclosed drawings, in which:

5 - Figure 1 is a plan view of a preferred embodiment of the mouse according to the present invention;

- Figures 2 to 5 show perspective and partially sectioned views of some alternative embodiments of
10 a component of the mouse according to the present invention; and

- Figure 6 shows an electric diagram of a component of the mouse according to the present invention.

15 With reference to the Figures, a preferred embodiment of the present invention is shown and described. It will be immediately obvious that numerous variations and modifications (for example related to shape, sizes, arrangements and parts
20 with equivalent functionality) could be made to what is described, without departing from the scope of the invention, as appears from the enclosed claims.

With reference to the Figures, it can be noted
25 that the mouse 1 according to the present

invention, or another similar electronic device, comprises at least one magnetic-mechanical harvester device 2 for generating electric current supplying the mouse 1 itself; in particular, such
5 harvester device 2 comprises:

- at least one mobile magnetic element 4 axially sliding along at least one translation axis A-A coaxial with at least one sliding guide 6 composed, for example, of at least a cylindrical room
10 containing therein such mobile magnetic element 4;
- at least one first spiral-type winding 16, or at least one of such first 16 and such second 17 spiral-type windings, made of electrically conductive material, such as a solenoid, a coil or
15 other suitable winding, adapted to concatenate the magnetic flux created by such mobile magnet 4, such spiral-type windings being preferably arranged symmetrically with respect to a balance position of such mobile magnet 4 and suitably separated by at
20 least one spacer ring 10 and suitably connected in series or counter-series, by winding the spiral in a common way, for example clockwise, or in a different way, for example counterclockwise;
- force optimizing elements 8, such as for

example elastic elements lie helical or conical springs, and/or fixed permanent magnets or other suitable ones, arranged in the side ends of such sliding guide 6.

5 Moreover, as shown in particular in Figures 4 and 5, the harvester device 2 can comprise at least one third spiral-type winding 18 and at least one fourth spiral-type winding 19, made of electrically conductive material, adapted to concatenate the
10 magnetic flux created by such mobile magnetic element 4, such spiral-type windings 18 and 19 being symmetrically arranged respectively with respect to spiral-type windings 17 and 16 and suitable separated therefrom by spacer rings 14 and
15 12; such spacer rings 12 and 14 can exclusively have the purpose of separating the windings 17, 18 and 16, 19 as shown in Figure 5, or, if made of ferromagnetic material as shown in Figure 4, make further balance positions for the mobile magnet 4
20 making the system multi-stable.

It can be noted how such force optimizing elements 8 can also be composed of such spacer rings 12, 14 placed between the windings 16, 17, 18, 19.

25 Moreover, as shown in particular in Figures 3

and 5, the mobile element of the harvester device 2 can be obtained as stack of magnets 4, 7 and 9 arranged in such a way that the faces with opposite polarity are adjacent, Figure 3; alternatively, the mobile element of the harvester device 2 can be obtained as stack of magnets 4, 7 and 9 arranged in such a way that the faces with the same polarity are adjacent and separated by ferromagnetic elements 20, 21, like in Figure 5.

10 Preferably, at least one of such harvester devices 2 is preferably arranged on such mouse 1 so that the translation axis A-A is parallel to the horizontal movement axis X of the mouse 1 itself, thereby allowing to obtain the maximum collection
15 of energy: obviously, such harvester device 2 can alternatively be arranged in any other position, without thereby departing from the scope of the present invention.

20 The harvester device 2 of the mouse 1 according to the present invention is therefore represented by a magnetic-mechanical transducer in which the force optimizing elements 8 are adapted to exert a force on the mobile magnetic element 4 which is thereby free of sliding along the sliding
25 guide 6.

Advantageously, the harvester device 2 can assume a first configuration of the mechanical type if such force exerted on the mobile magnetic element 4 is of a mechanical nature: in such case, 5 the force optimizing elements 8 can be composed of elastic elements adapted to enable the sliding of the mobile magnetic element 4 along the sliding guide 6 when the mouse 1 is under mechanical vibration, for example during the manual sliding of 10 the mouse 1 on the bearing surface, preferably along the direction of axis X parallel to the translation axis A-A of the sliding guide 6.

Moreover, advantageously, the harvester device 2 can assume a second configuration of the magnetic 15 type if such force exerted on the mobile magnetic element 4 is of a magnetic nature: in such case, the force optimizing elements 8 can be composed of fixed magnetic elements and arranged so that each fixed magnetic element and the mobile magnetic 20 element 4 are mutually oriented in order to oppose the two faces with the same polarity, in order to generate a repulsion force, enabling the repulsion between such fixed magnetic element and such mobile magnetic element 4, which is free of sliding along 25 the sliding guide 6.

Moreover, advantageously, the harvester device
2 can assume a third configuration of the
mechanical-magnetic type: in such case, one of such
force optimizing elements 8 is composed of an
5 elastic element while another one of such force
optimizing elements 8 is composed of a fixed
magnetic element, such force optimizing elements 8
thereby exerting on the mobile magnetic element 4
respectively and simultaneously, a mechanical force
10 and a magnetic force. The fixed magnetic element
and the mobile magnetic element 4, in such case,
are mutually oriented in order to oppose the two
faces with the same polarity, in order to generate
a repulsion force, simultaneously enabling the
15 repulsion between such fixed magnetic element and
such mobile magnetic element 4 and the mechanical
action of the elastic element.

The mobile magnetic element 4, as shown in
Figures 2 and 4, or 4, 7 and 9, as shown in Figures
20 3 and 5, have physical sizes suitable for its use
and alternately moves around its balance position,
or its balance positions, generating a magnetic
field, in which such spiral-type windings 16, 17,
18, 19 are immersed: such magnetic field creates a
25 magnetic flux thereby concatenated on each spiral-

type winding 16, 17, 18, 19 and, when there is relative movement, an electric voltage.

The mouse 1 according to the present invention further comprises managing means 11 of the operation of the harvester device 2 adapted to process the magnetic-mechanical signal transduced by the harvester device 2 into an electric signal: such harvester device 2 is therefore adapted to generate electric current and to provide the necessary supply for using the mouse 1.

In particular, as it is possible to note in Figure 6, the harvester device 2 is schematically shown as an electric voltage generator, and in particular every spiral-type winding 16, 17, 18, 19 is connected to such managing means 11. Such managing means 11 comprise:

- at least one rectifying and leveling circuit 13, composed for example of a diode bridge or another suitable one, adapted to filter and level at least one voltage value induced on every spiral-type winding 16, 17, 18, 19 and to obtain a direct current value,
- means 15 for stabilizing the electric current, composed for example of at least one capacitor, a load resistance, a resistance in

parallel with such capacitor, or other suitable one.

Obviously, the configuration of such managing means 11 can be optimized to maximize the performances of the harvester device 2 with advanced electronic elements of the passive, adaptive, semi-active or active types, allowing to reach high energy densities depending on the low intensity and the low frequency values which characterize the motion of the mouse 1.

The invention as described above thereby allows obtaining at least the following advantages:

- providing a mouse having the necessary supply for its use, provided by the harvester device for generating electricity integrated in the mouse itself;
- reducing environmental impacts by replacing the primary battery of the mouse with the harvester device;
- optimizing the operation of the harvester device with elastic elements which improve its performances;
- allowing to reach high energetic density values depending on the accelerations transmitted by the manual use of the mouse,

which are characterized by low frequency and intensity values;

- guaranteeing the adaptability and operation of such harvester device also in other electronic consumer devices.

CLAIMS

1. Mouse (1), comprising at least one magnetic-mechanical harvester device (2) for generating electric current supplying said mouse (1), said
5 harvester device (2) comprising:
- at least one mobile magnetic element (4) axially sliding along at least one translation axis A-A coaxial with at least one sliding guide (6);
 - force optimizing elements (8) arranged in the
10 side ends of said sliding guide (6) adapted to exert at least one force having an elastic and/or mechanical nature onto said mobile magnetic element (4), enabling a sliding of said mobile magnetic element (4) along said sliding
15 guide (6);
 - at least one first spiral-type winding (16), made of electrically conductive material, adapted to concatenate a magnetic flux created by said mobile magnet (4);
 - 20 - a second spiral-type winding (17), made of electrically conductive material, adapted to concatenate said magnetic flux created by said mobile magnet (4);
- characterized in that said force optimizing

elements (8) are at least two elastic elements adapted to exert at least one mechanical force onto said mobile magnetic element (4) along said sliding guide (6) when said mouse (1) is under mechanical
5 vibration; and

in that said force optimizing elements (8) are at least one elastic element and at least one fixed magnetic element.

2. Mouse (1) according to claim 1, characterized
10 in that said translation axis A-A is parallel to a horizontal movement axis X of said mouse (1).

3. Mouse (1) according to claim 1, characterized in that said force optimizing elements (8) are at least two fixed magnetic elements, said fixed
15 magnetic elements and said mobile magnetic element (4) being mutually oriented in order to oppose the two faces with the same polarity.

4. Mouse (1) according to claim 1, characterized in that said harvester device (2) comprises at
20 least one second mobile magnetic element (7) and a at least one third mobile magnetic element (9) arranged along said sliding guide (6) and placed so that the faces with the same polarity or opposite polarity are arranged one adjacent to the other,
25 generating a repulsion or attraction force.

5. Mouse (1) according to claim 1, characterized in that said harvester device (2) comprises at least one third spiral-type winding (18) and at least one fourth spiral-type winding (19), made of
5 electrically conductive material, said windings (18, 19) being adapted to concatenate at least one magnetic flux created by said mobile magnetic element (4).

6. Mouse (1) according to the previous claim,
10 characterized in that said first and said second spiral-type windings (16, 17) are arranged symmetrically with respect to at least one balance position of said mobile magnet (4).

7. Mouse (1) according to claim 5 or 6,
15 characterized in that it comprises ferromagnetic spacers (12, 14) and in that said third spiral-type winding (18) and said fourth spiral-type winding (19) are arranged symmetrically with respect to balance positions of said mobile magnet (4)
20 respectively with respect to said second and first spiral-type windings (17, 16) when said mobile magnet (4) has many of said balance positions.

8. Mouse (1) according to claim 1, characterized in that said sliding guide (6) is at least one
25 cylindrical room containing therein said mobile

magnetic element (4).

9. Mouse (1) according to any one of the previous claims, characterized in that it comprises managing means (11) for an operation of said
5 harvester device (2).

10. Mouse (1) according to the previous claim, characterized in that said spiral-type windings (16, 17, 18, 19) are individually connected to said managing means (11).

10 11. Mouse (1) according to claim 9, characterized in that said managing means (11) comprise at least one rectifying circuit (13) and at least stabilizing means (15).

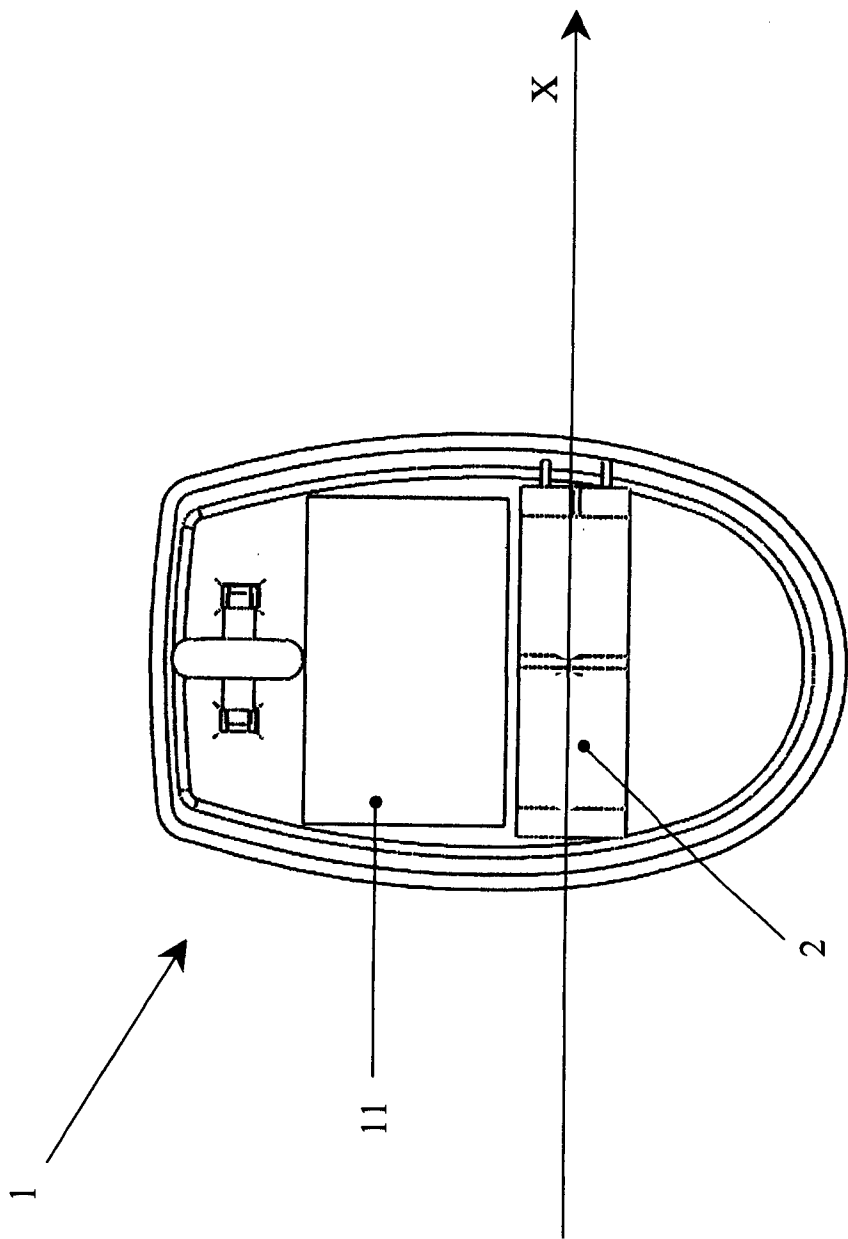


FIG. 1

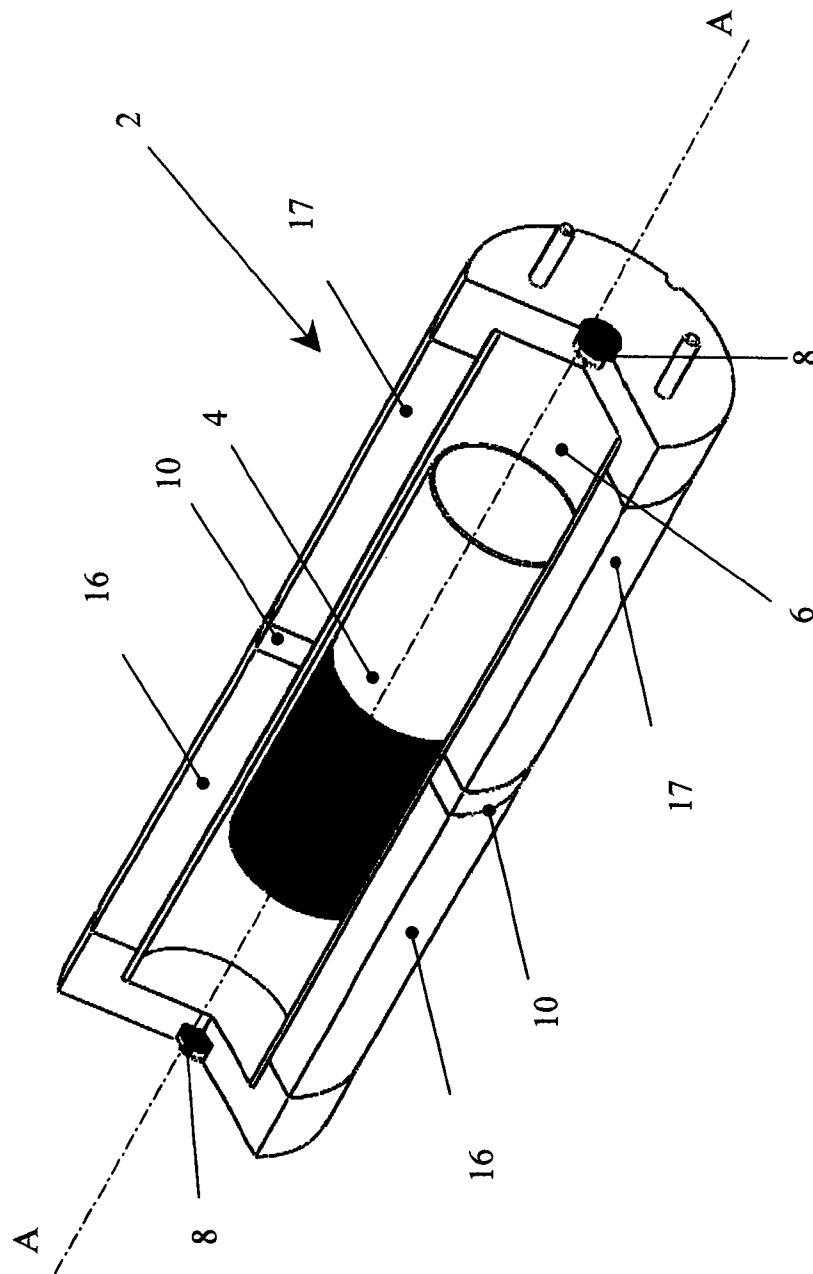


FIG. 2

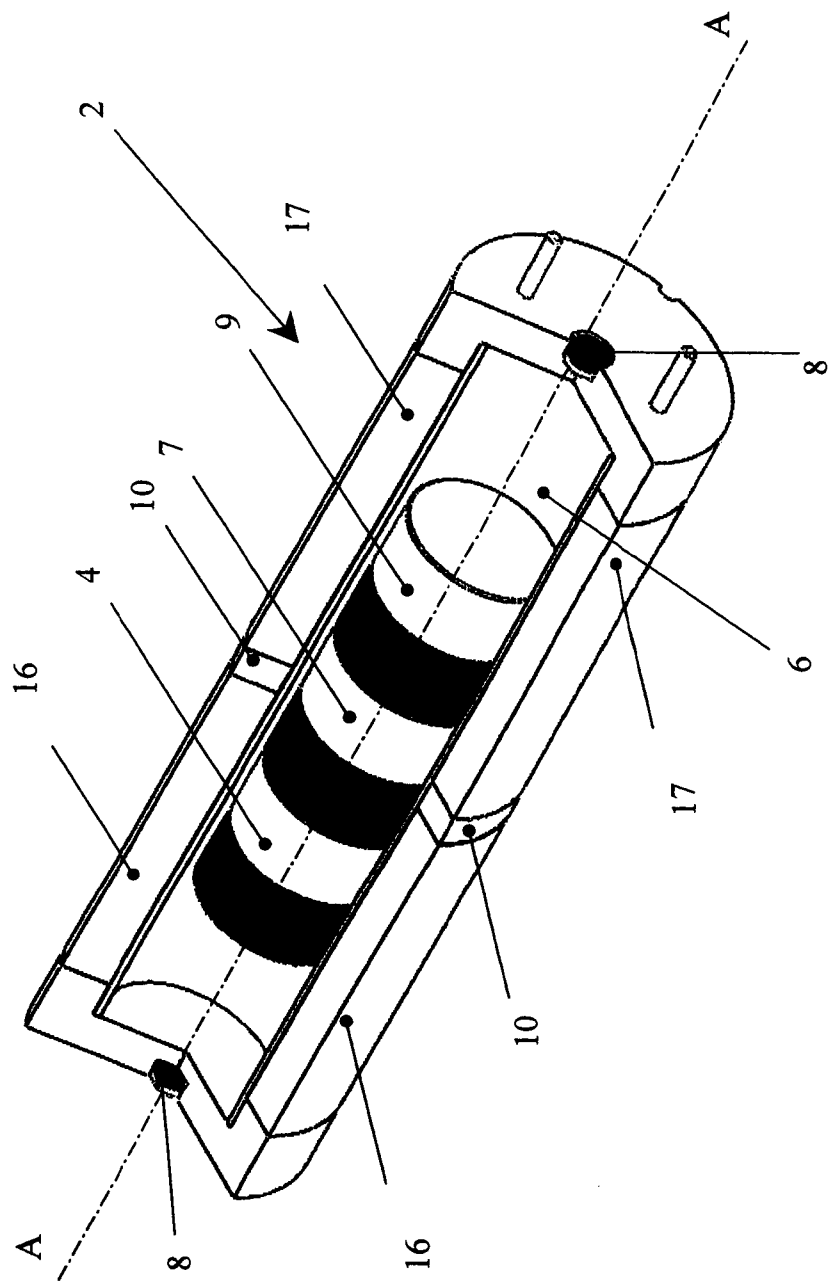


FIG. 3

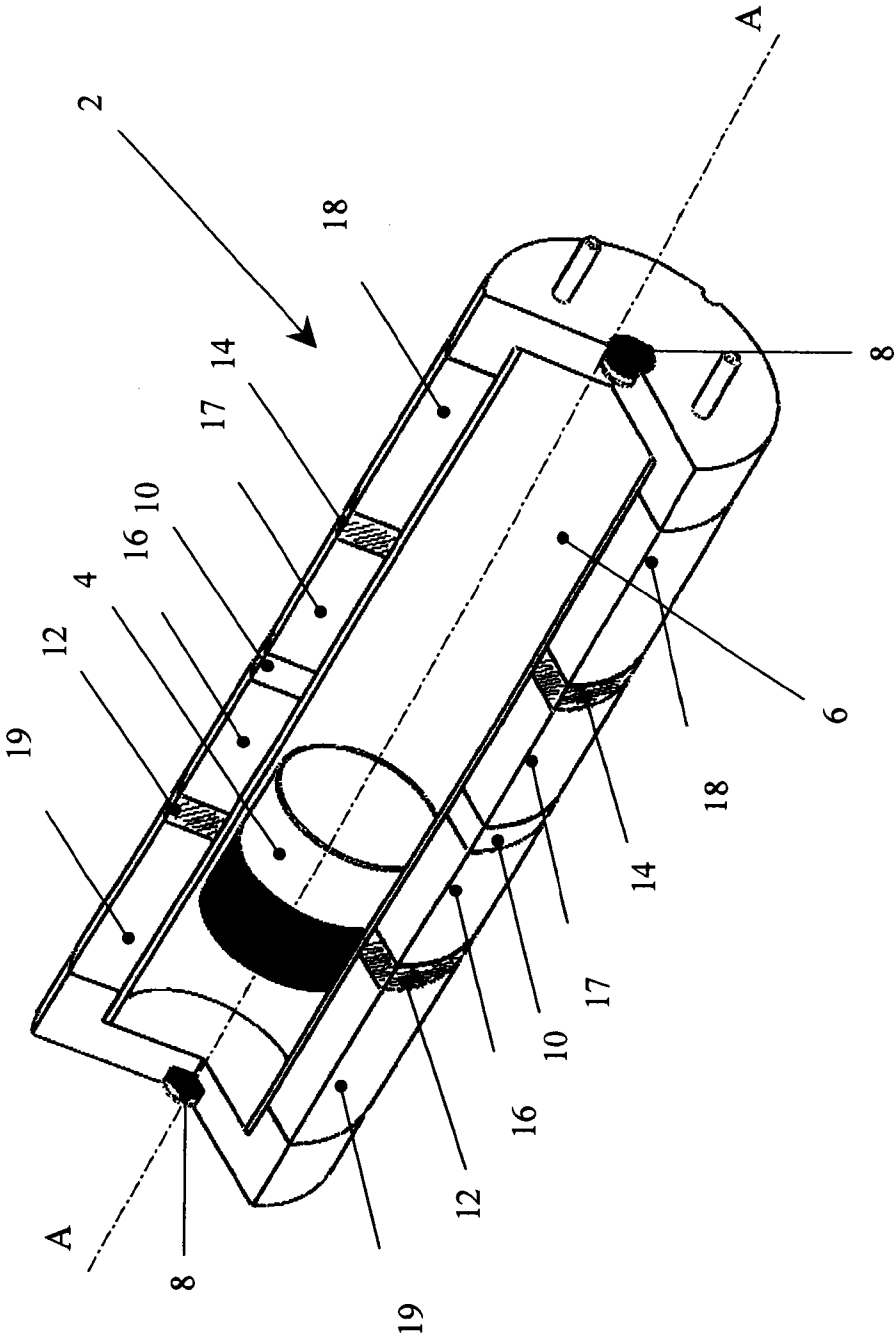


FIG. 4

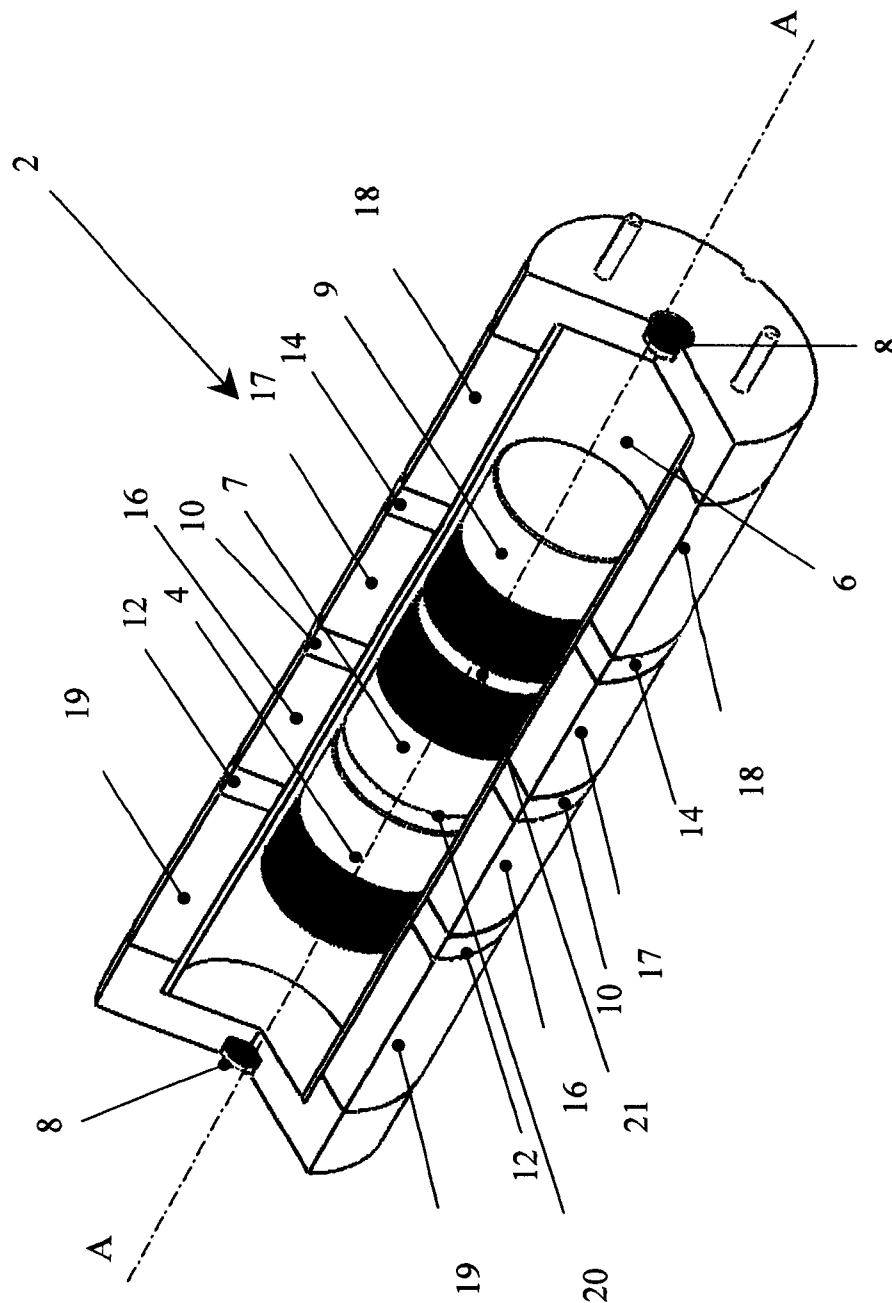


FIG. 5

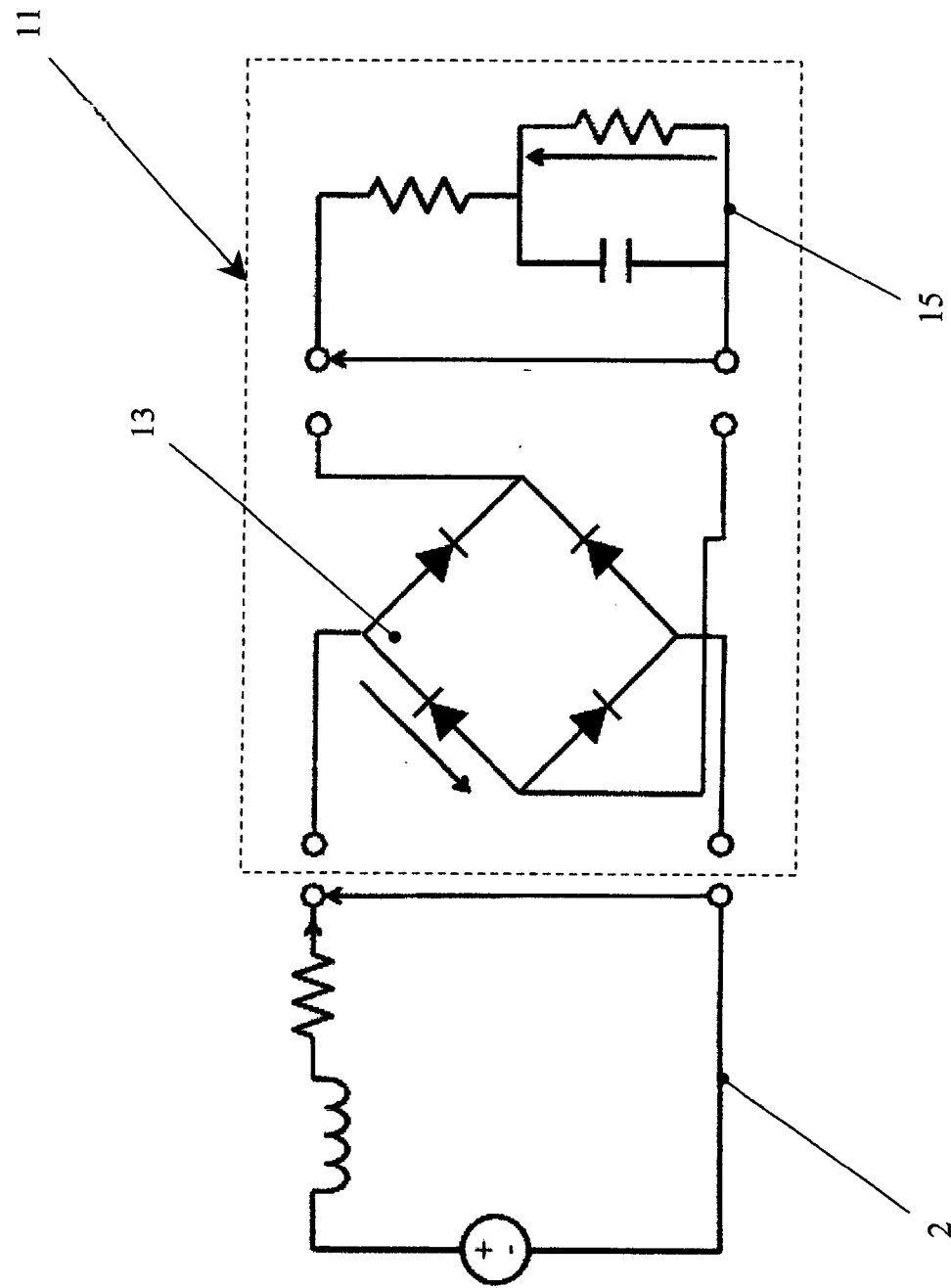


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No

PCT/IT2014/000195

A. CLASSIFICATION OF SUBJECT MATTER

INV. G06F3/033 H02K35/02
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H02K G06F

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2 425 003 A (GIGA BYTE TECH CO LTD [TW]) 11 October 2006 (2006-10-11) abstract figures 2-4 page 1 - page 7	1-11
Y	US 2003/197433 A1 (CHEUNG JEFFREY T [US] ET AL) 23 October 2003 (2003-10-23) abstract page 1; figures 4-12 paragraph [0007] - paragraph [0049]	1-11
Y	CN 102 043 476 A (INVENTEC CORP) 4 May 2011 (2011-05-04) abstract figures 1-4 page 1 - page 5	1-11
	-/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

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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.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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