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(54) DEVICE FOR GENERATING HEAT BY MEANS OF MAGNETIC INDUCTION

(57) The invention relates to a device for generating heat by means of magnetic induction, which comprises: an element (1) of thermoconductive material with a channel (4) for circulating a fluid to be heated; and a set of discs (2) with permanent magnets (3) which face the element (1) of thermoconductive material and are designed to exert a variable magnetic field on the element (1) of thermoconductive material, the set of discs (2) comprising first motorised discs (2.1) and at least one free-rotating second disc (2.2), wherein the first discs (2.1) are disposed around the second disc (2.2), such that the second disc (2.2) is rotated by the magnetic influence exerted by the permanent magnets (3) of the first discs (2.1).

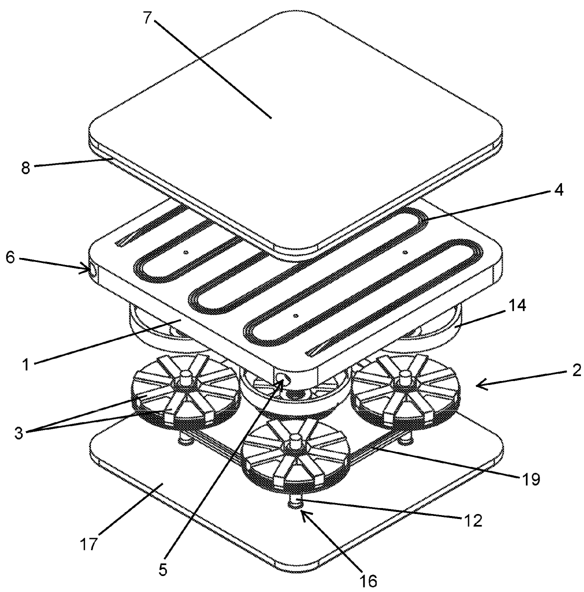

FIG. 1

Description

Technical field

[0001] The present invention relates to heat generation for heating applications, proposing a device that allows heat to be produced by means of magnetic induction under cost-effective conditions for heating of fluids or similar applications.

State of the art

[0002] It is known that when an element of electrically conductive material is arranged within the scope of a magnetic field of a moving magnet, the influence of the variable magnetic field acting on that element generates a heat therein that causes heating.

[0003] Based on this phenomenon, solutions aimed at the heating of circulating fluids through a copper tube or other electrically conductive material have been developed, with a magnet carrier disc associated with a rotation drive motor arranged in relation to the tube.

[0004] Solutions of this type are described, for example, in documents ES1077579U, US2549362A, US20090223948A1, US5012060A, US7339144B2, US8408378B1 or US20110272399A1, all based on approaches using a magnet carrier support rotatably driven by a motor to create, by means of moving magnets, a variable magnetic field in relation to a metal tube for circulating a fluid to be heated. These solutions have not, however, been successful in practical implementation, due to the low heat production performance they offer in relation to the energy consumption required to rotate the magnet carrier support.

Object of the invention

[0005] In accordance with the present invention, a device for generating heat by magnetic induction is proposed, based on magnet movement, which achieves an efficiency that improves the performance of known solutions in that regard and, consequently, the application capacity.

[0006] The device for generating heat by magnetic induction comprises an element of thermoconductive material with a channel for circulating a fluid to be heated, and a set of discs with permanent magnets facing the element of thermoconductive material and which are designed to exert a variable magnetic field on the element of thermoconductive material. The set of discs comprises first motorised discs and at least one free-rotating second disc, wherein the first discs are arranged around the second disc, such that the second disc is rotated by the magnetic influence exerted by the permanent magnets of the first discs.

[0007] The heat generated on the element of thermoconductive material is a function of the number of magnetic field changes and, therefore, of the number of permanent magnets incorporated in the discs and their rotational speed. In this regard, the device and the invention propose to use at least one second disc that rotates due to the magnetic influence exerted by the first discs that are arranged around the second disc, which allows reducing the energy consumption necessary to rotate the set of discs, thus increasing the functional performance of the device.

[0008] The channel for circulating a fluid is a groove that is directly made on a face of the element of thermoconductive material, such that the fluid is in direct contact with the element to be heated. Preferably, the channel has a rough surface for increasing the fluid contact area, and thus creating a turbulent fluid flow that optimises thermal transfer.

[0009] On the face of the element of thermoconductive material that has the channel there is a closure cap with a sealing gasket that establishes a tight seal between the element and the closure cap and, therefore, prevents possible leaks that may occur in the channel through which the fluid to be heated circulates. The closure cap may be of a thermoconductive material, such as aluminum.

[0010] The element of thermoconductive material has a slotted distribution on the face opposite to where the channel is, such that the surface exposed to the variable magnetic field generated by the permanent magnets is increased, while said slotted zone is heated faster than the rest of the element material. Preferably, the slotted distribution has a circular shape reciprocal to the shape of the set of discs that facilitates rotation of the discs.

[0011] Preferably, the set of discs comprises four first discs arranged according to a quadrangular peripheral distribution and a second disc that is arranged in the centre of the distribution formed by the first discs.

[0012] The discs comprise a disc body with housings for the permanent magnets, a rotation shaft and a first and a second support that retain the permanent magnets in the housings. The first support has a first inner threaded surface threading onto a reciprocal outer threaded surface of a first end of the rotation shaft, while the second support has a second inner threaded surface threading onto a reciprocal outer threaded surface of the disc body.

[0013] The rotation shaft of the first discs has a second end with a grooved zone for receiving a transmission means connecting the first discs in rotation, while the rotation shaft of one of the first discs is coupled to a drive motor, such that one of the first discs is driven directly by the motor while the rest of the first discs are driven through the transmission means, the second disc being rotated by the magnetic influence exerted by the permanent magnets of the first discs.

[0014] Therefore, the device for generating heat object of the invention results from constructive and functional features that make it advantageous for the function for which it is intended, its embodiment taking on a life of its own and preferential character over conventional devices for the same application.

Description of the figures

[0015]

Figure 1 shows an exploded perspective view of the elements comprising the device for generating heat of the invention.

Figure 2 shows a front exploded view of the device for generating heat of the invention.

Figure 3 shows a plan view of an exemplary embodiment of the set of discs with permanent magnets of the device for generating heat.

Figure 4 shows a top plan view of the element of thermoconductive material.

Figure 5 shows a bottom plan view of the element of thermoconductive material.

Figure 6 shows the section VI-VI of the element of thermoconductive material shown in Figure 4.

Figure 7 shows the section VII-VII of the element of thermoconductive material shown in Figure 4.

Figures 8 and 9 respectively show a top and bottom perspective view of one of the first discs of the device for generating heat.

Figure 10 shows an exploded sectional view of the elements comprising one of the first discs of the device for generating heat.

Figure 11 shows a mounted sectional view of the elements comprising one of the first discs of the device for generating heat.

Detailed description of the invention

[0016] The object of the invention relates to a device for generating heat by means of magnetic induction, comprising an element (1) of thermoconductive material such as aluminum and a set of discs (2) with permanent magnets (3) that are arranged facing the element (1) of thermoconductive material, wherein the discs (2) with permanent magnets (3) are rotatably driven causing a variable magnetic field that expands over the element (1) of thermoconductive material heating it. The element (1) of thermoconductive material has a coil-shaped channel (4) through which a fluid to be heated circulates.

[0017] The permanent magnets (3) of each disc (2) are arranged radially according to an alternating polarity distribution, so that they exert a variable magnetic field that causes successive magnetisations and demagnetisations of the thermoconductive material of the element (1), which results in an electromagnetic loss that produces a heat that by thermal transmission heats the fluid of the channel (4).

[0018] Said element (1) of thermoconductive material is a block preferably of flat configuration that, on one of its larger faces, has the channel (4) for the circulation of fluid. The channel (4) is, for example, a groove that is directly made on the element (1) of thermoconductive material, such that the fluid to be heated circulating in the channel (4) is in direct contact with the thermoconductive material, maximising thermal transfer. A fluid inlet (5) and outlet (6) to the channel (4) are arranged on one of the smaller faces of the element (1) of thermoconductive material.

[0019] On the larger face of the element (1) of thermoconductive material having the channel (4) there is a closure cap (7) with a sealing gasket (8) that establishes a tight seal between the element (1) of thermoconductive material and the closure cap (7) to prevent fluid leaks from the channel (4). The closure cap (7) is of a thermoconductive material, for example of the same material as the element (1), such that heat transfer to the channel fluid (4) is optimised.

[0020] Advantageously, the channel (4) has a rough surface that allows increasing the contact area with the fluid circulating through the channel (4), thereby improving the transmission of heat to the fluid. The rough surface of the channel (4) may be protrusions, fins, or any other shape that causes turbulent flow of the fluid circulating through the interior of the channel 4, thereby increasing heating efficiency.

[0021] As seen in Figure 5 and in the sectional views of Figures 6 and 7, the element (1) of thermoconductive material has a slotted distribution (9) on the larger face opposite the other larger face wherein the channel (4) is arranged, said slotted distribution increases the surface and allows faster heating of the element (1). Preferably, and as seen in Figure 5, the slotted distribution (9) has a circular shape reciprocal to that of the discs (2), which enhances the rotation of the discs (2) thus reducing the energy consumption for their driving.

[0022] The set of discs (2) with permanent magnets (3) comprises first motorised discs (2.1) and at least one free-rotating second disc (2.2). The first discs (2.1) are arranged around the second disc (2.2), so that the permanent magnets (3) of the first discs (2.1) generate a magnetic influence on the permanent magnets of the second disc (2.2) causing their rotation, thereby optimising the energy consumption of the device for driving the set of discs (2).

[0023] Preferably, and as seen in Figure 3, the device comprises four motorised discs (2.1) and a free-rotating disc (2.2), thus the set of discs (2) is formed by four first discs (2.1) arranged according to a quadrangular peripheral distribution surrounding a second disc (2.2) that is arranged in the centre of said quadrangular distribution close to the first discs (2.1).

[0024] As can be seen in Figure 3, the number of permanent magnets (3) incorporated in each disc (2) is an even number, so that an alternating polarity distribution is obtained in each disc (2). Also, as seen in Figure 11, the permanent magnets (13) have a polarity on their upper face and an opposite polarity on their lower face, such that the generated magnetic field is directed in a direction perpendicular to the faces of the permanent magnets (3), and therefore the magnetic field is directed towards the element (1) to be heated since the discs (2) are arranged facing and parallel to the element (1) to be heated.

[0025] As shown in Figures 8 to 11, the first discs (2.1) comprise a disc body (10) with housings (11) for the permanent magnets (3) on its upper face, a rotation shaft (12) extending in the axial direction of the disc (2.1) and supports (13, 14) for the permanent magnets (3) closing the housings (11) of the disc body (10).

[0026] The rotation shaft (12) has a first end (12.1) that is arrangeable in a housing (15) of the element (1) of thermoconductive material (see Figure 5) and a second end (12.2) that is arrangeable in a housing (16) of a support plate (17) of the device (see Figure 1), such that the discs (2) are arranged with the possibility of rotation between the element (1) of thermoconductive material and the support plate (16).

[0027] The rotation shaft (12) has at its second end (12.2) a grooved zone (18) for receiving a transmission means (19), such as a belt, distribution chain, or the like, which rotationally connects the first discs (2.1). Thus, as seen in Figure 2, the rotation shaft (12) of one of the first discs (2.1) is directly coupled to a drive motor (20) arranged in the support plate (17), such that the rest of the first discs (2.1) are motorised through the transmission means (19) that transmits the rotation of the drive motor (20). It is also possible that each first disc (2.1) has an independent drive motor (20), but the rotation of the second disc (2.2) is always caused by the magnetic influence exerted by the permanent magnets (3) of the first discs (2.2) located near their surroundings.

[0028] The first support (13) has a first inner threaded surface threading onto a reciprocal outer threaded surface of the first end (12.1) of the rotation shaft (12), while the second support (14) has a second inner threaded surface threading onto a reciprocal outer threaded surface of the disc body (11), such that the permanent magnets (3) are retained in the housings (11) of the disc body (10) by means of the supports (13, 14) preventing their movement, which is especially relevant to avoid deviations in the magnetic field lines and, therefore, misalignments in the rotation shaft (12) of the discs (2) that may negatively affect the performance of the device.

[0029] The housings (11) have a rectangular shape reciprocal to the shape of the permanent magnets (3) which are arranged in the housings (11). Such a rectangular configuration of the permanent magnets (3) allows to magnetise a larger surface of the element (1), and thus improve the heating efficiency.

[0030] The configuration of the second disc (2.2) is identical to that of the first discs (2.1) except that it does not need to have a grooved zone (18) at the second end (12.2) of the rotation shaft (12), since the rotation of the second disc (2.2) is carried out by the magnetic influence exerted by the permanent magnets (3) of the first discs (2.1).

[0031] It is provided that the diameter of the second disc (2.2) be less than the diameter of the first discs (2.1) to facilitate its movement due to magnetic influence; however, the second disc diameter (2.2) could be less than or greater than the diameter of the first discs (2.1).

Claims

1. A device for generating heat by means of magnetic induction, **characterised in that** it comprises:

   - an element (1) of thermoconductive material with a channel (4) for circulating a fluid to be heated, and
   - a set of discs (2) with permanent magnets (3) facing the element (1) of thermoconductive material and which are designed to exert a variable magnetic field on the element (1) of thermoconductive material, the set of discs (2) comprises first motorised discs (2.1) and at least one free-rotating second disc (2.2), wherein the first discs (2.1) are arranged around the second disc (2.2), such that the second disc (2.2) is driven in rotation by the magnetic influence exerted by the permanent magnets (3) of the first discs (2.1).

2. The device for generating heat by means of magnetic induction according to claim 1, **characterised in that** the channel (4) for circulating a fluid is a groove that is directly made on a face of the element (1) of thermoconductive material.

3. The device for generating heat by means of magnetic induction according to the preceding claim, **characterised in that** the channel (4) has a rough surface to increase the area of contact with the fluid.

4. The device for generating heat by means of magnetic induction according to claim 2, or 3, **characterised in that** on the face of the element (1) of thermoconductive material having the channel (4) there is a closure cap (7) with a sealing gasket (8) that establishes a tight seal between the element (1) and the closure cap (7).

5. The device for generating heat by means of magnetic induction according to the preceding claim, **characterised in that** the closure cap (7) is made of a thermoconductive material, such as aluminum.

6. The device for generating heat by means of magnetic induction according to any one of the preceding claims, **characterised in that** the element (1) of thermoconductive material has a slotted distribution (9) on the face opposite to the channel (4).

7. The device for generating heat by means of magnetic induction according to the preceding claim, **characterised in that** the slotted distribution (9) has a circular shape reciprocal to the shape of the set of discs (2).

8. The device for generating heat by means of magnetic induction according to any one of the preceding

claims, **characterised in that** the set of discs (2) comprises four first discs (2.1) arranged according to a quadrangular peripheral distribution and a second disc (2.2) that is arranged in the centre of the distribution formed by the first discs (2.1).

9. The device for generating heat by means of magnetic induction according to any one of the preceding claims, **characterised in that** the discs (2) comprise a disc body (10) with housings (11) for the permanent magnets (3), a rotation shaft (12) and a first and a second support (13, 14) that retain the permanent magnets (3) in the housings (11).

10. The device for generating heat by means of magnetic induction according to the preceding claim, **characterised in that** the rotation shaft (12) has a first end (12.1) insertable into a housing (15) of the element (1) of thermoconductive material and a second end (12.2) insertable into a housing (16) of a support plate (17).

11. The device for generating heat by means of magnetic induction according to any one of claims 9 to 10, **characterised in that** the first support (13) has a first inner threaded surface threading onto a reciprocal outer threaded surface of a first end (12.1) of the rotation shaft (12), while the second support (14) has a second inner threaded surface threading onto a reciprocal outer threaded surface of the disc body (10).

12. The device for generating heat by means of magnetic induction according to any one of claims 9 to 11, **characterized in that** the housings (11) have a rectangular shape reciprocal to the shape of the permanent magnets (3).

13. The device for generating heat by means of magnetic induction according to any one of claims 9 to 12, **characterised in that** the rotation shaft (12) of the first discs (2.1) has a second end (12.2) with a grooved zone (18) for receiving a transmission means (19) that rotationally connects the first discs (2.1), and the rotation shaft (12) of one of the first discs (2.1) is coupled to a drive motor (20).

14. The device for generating heat by means of magnetic induction according to any one of the preceding claims, **characterised in that** the diameter of the second disc (2.2) is less than the diameter of the first discs (2.1).

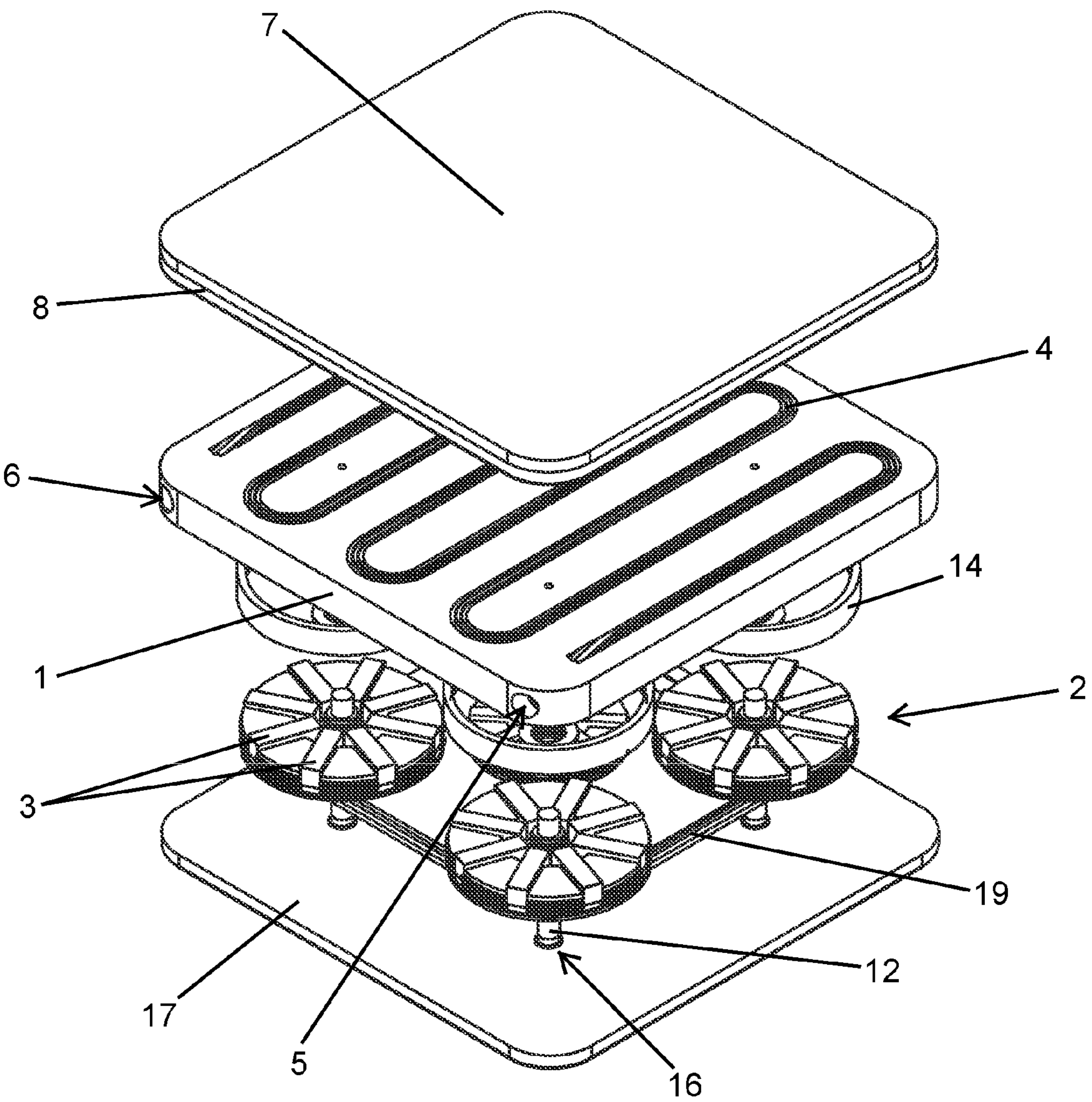

FIG. 1

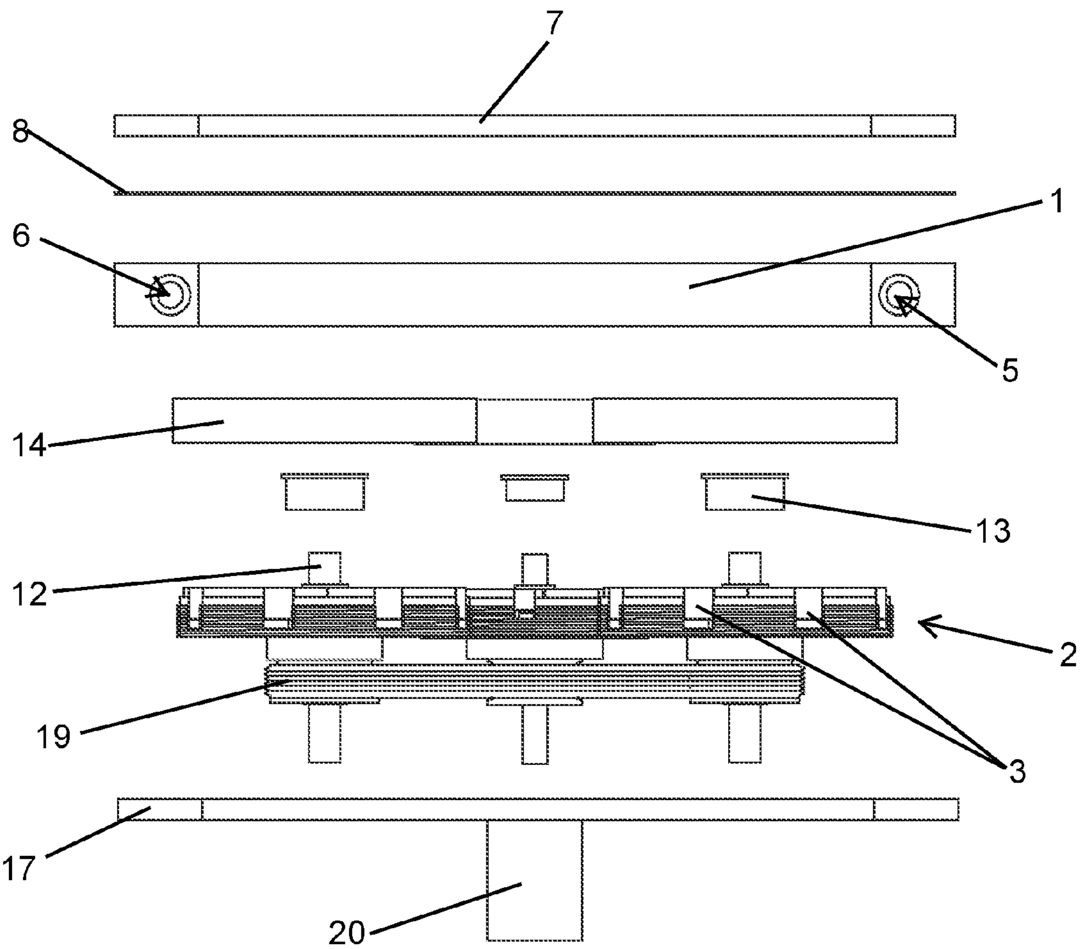

FIG. 2

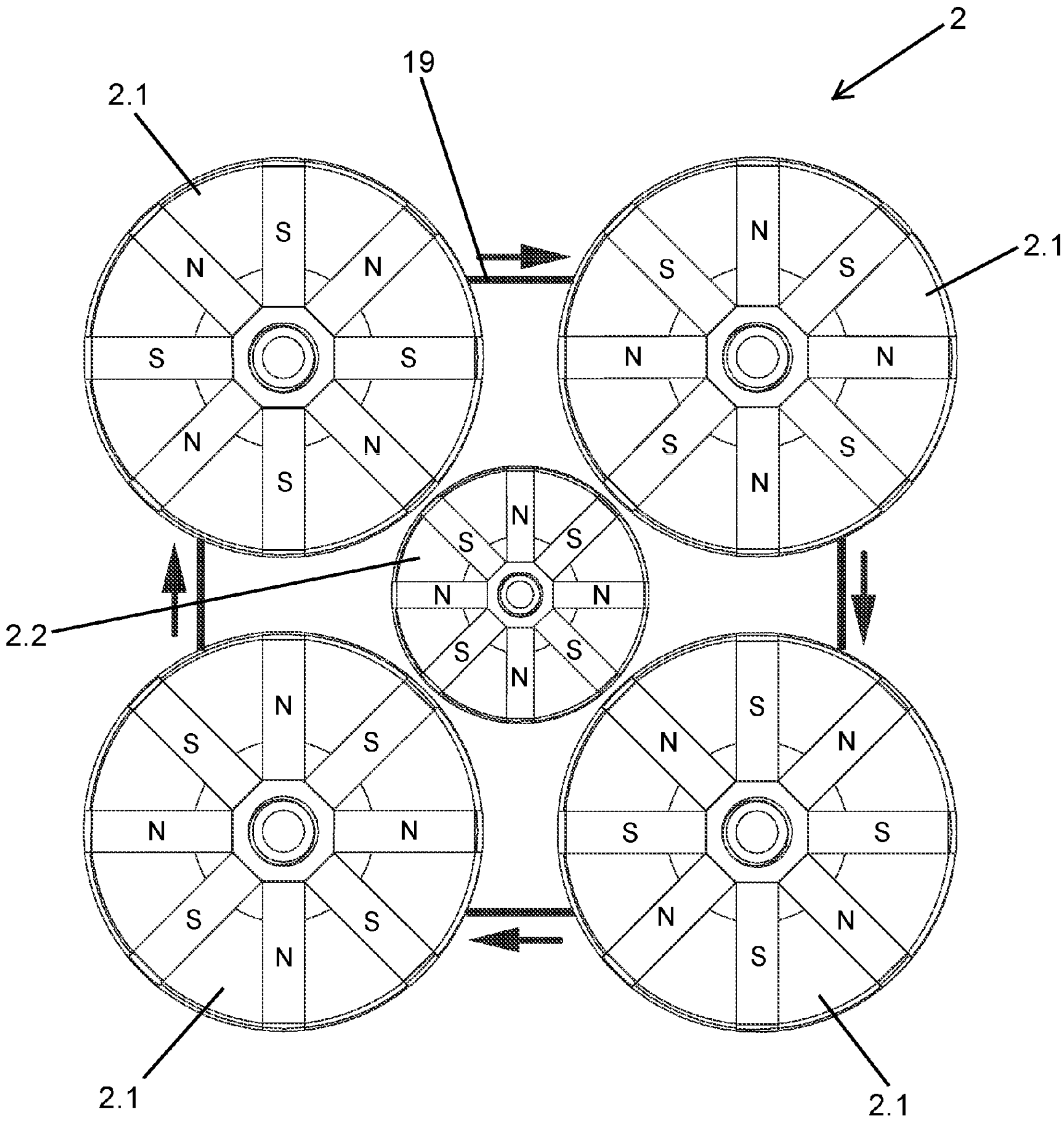
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FIG. 3

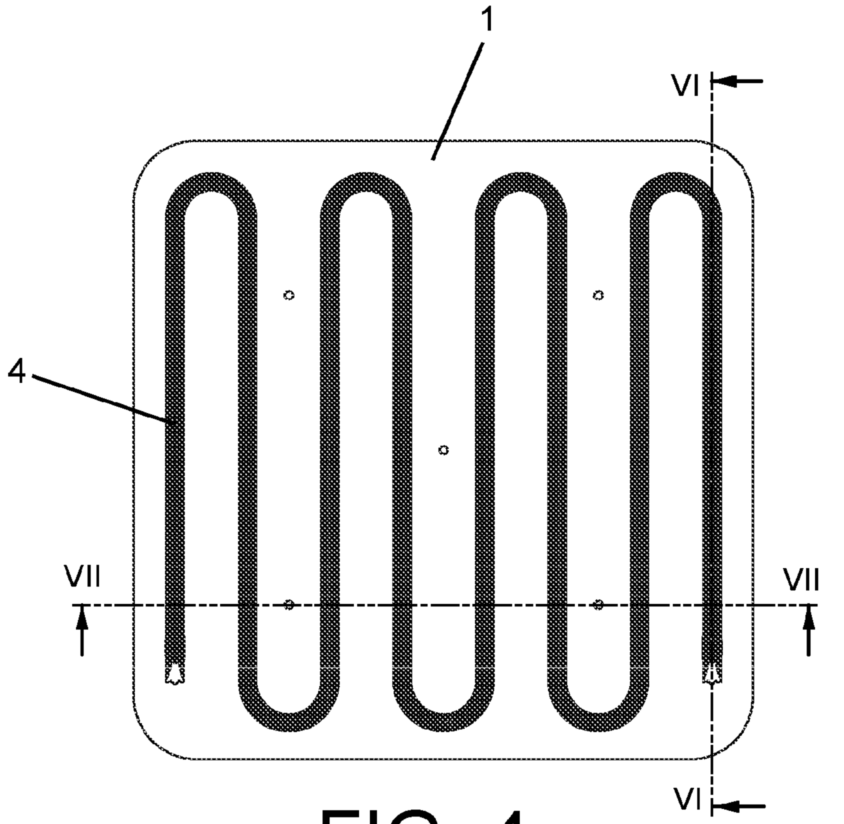

FIG. 4

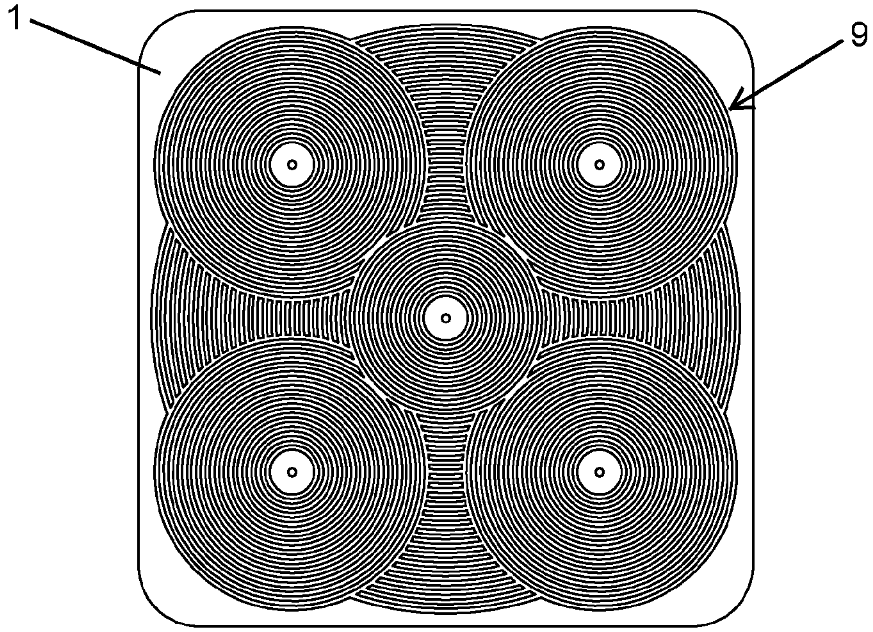

FIG. 5

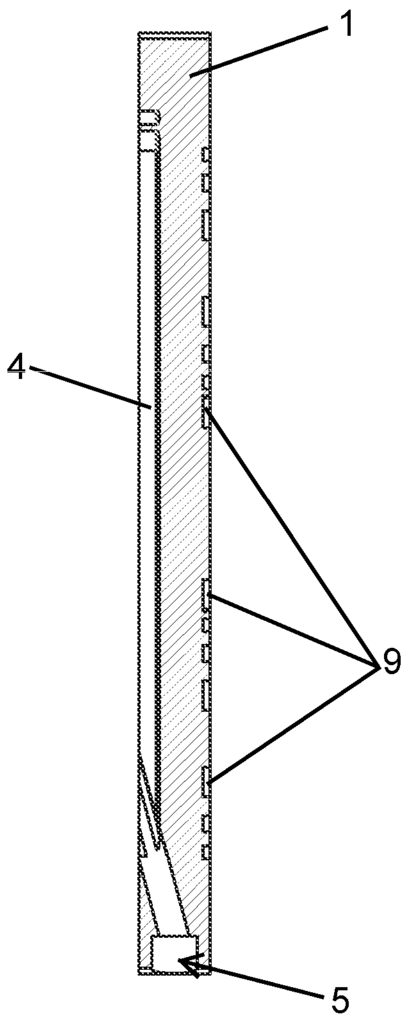

FIG. 6

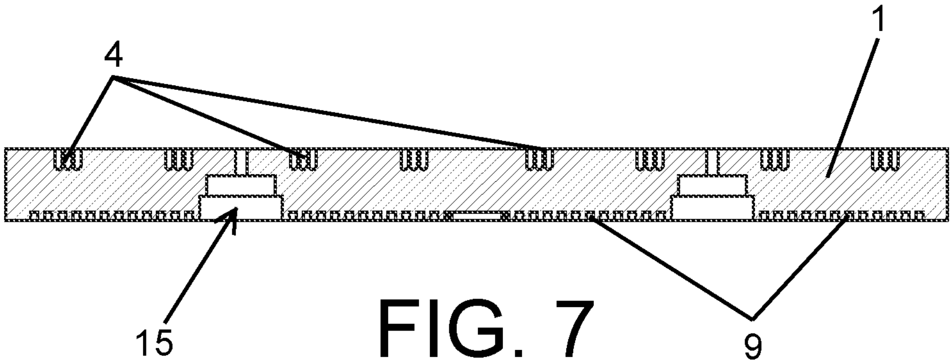

FIG. 7

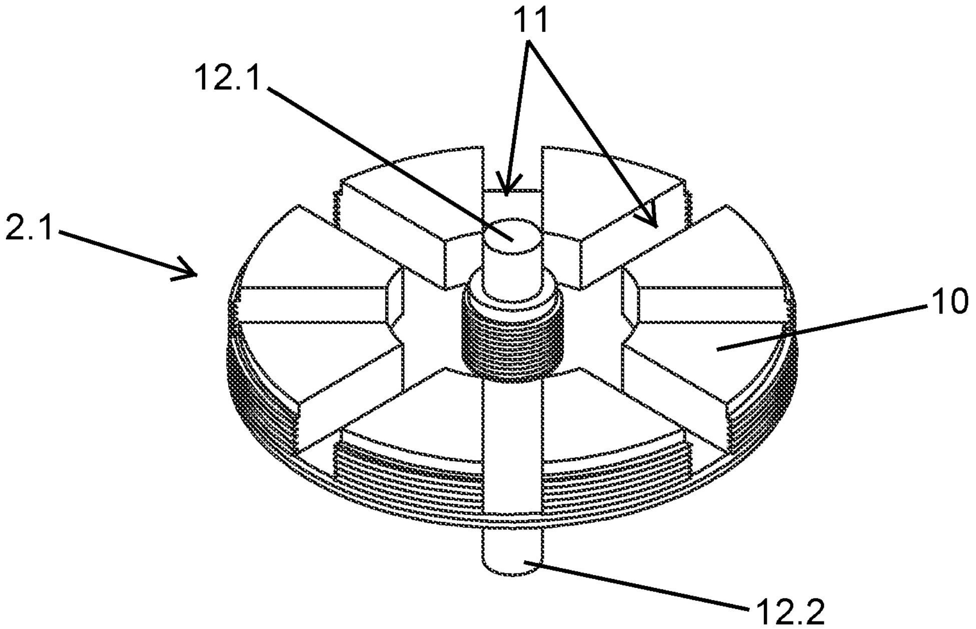

FIG. 8

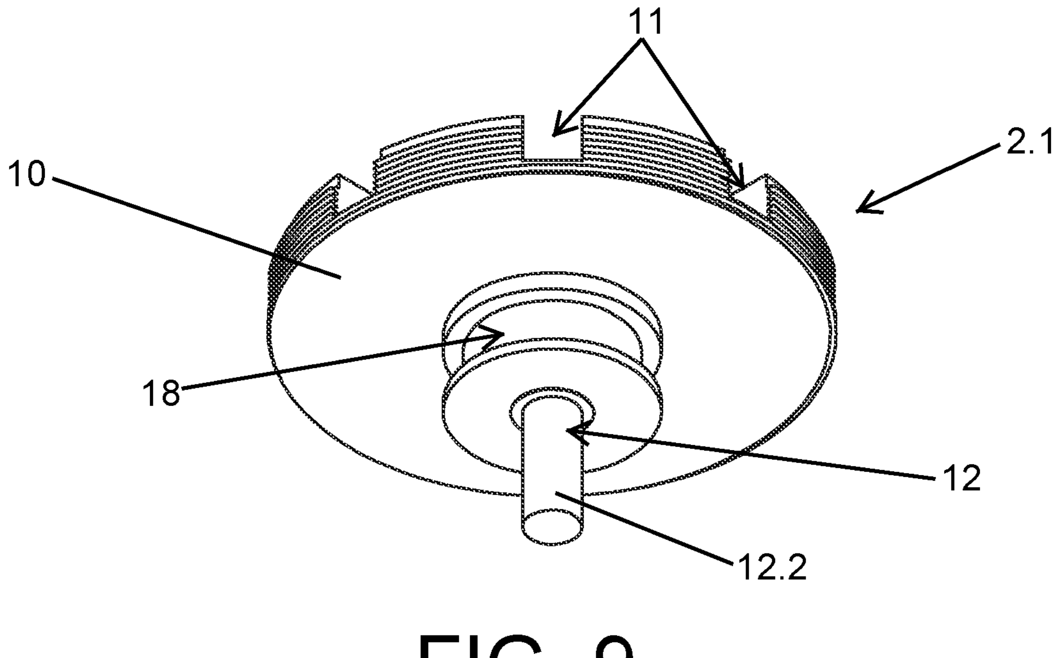

FIG. 9

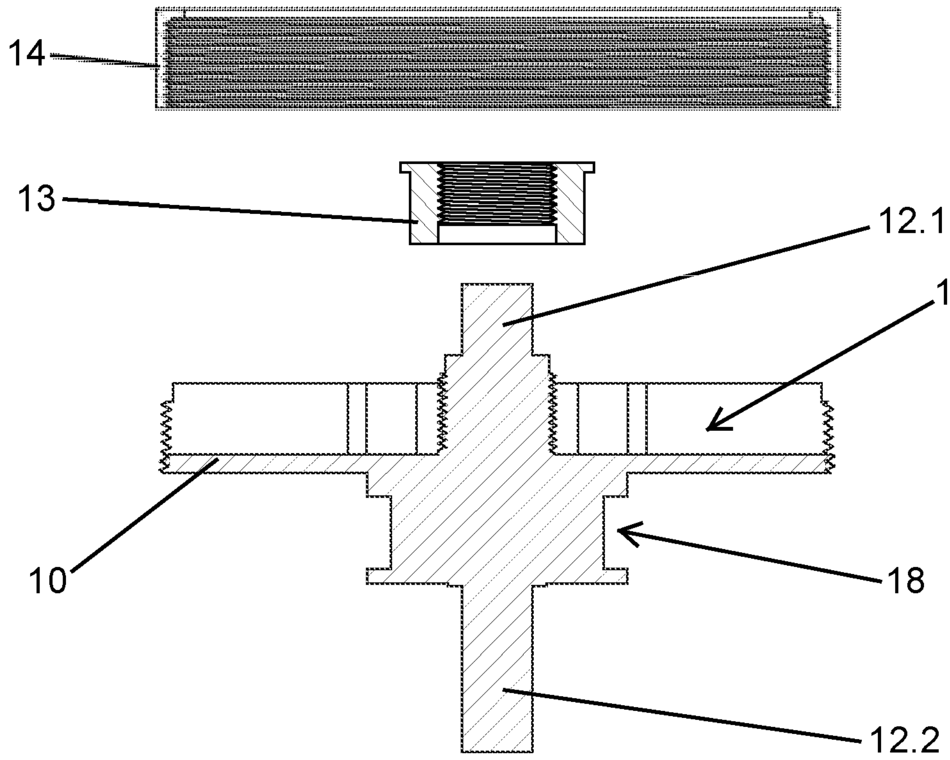

FIG. 10

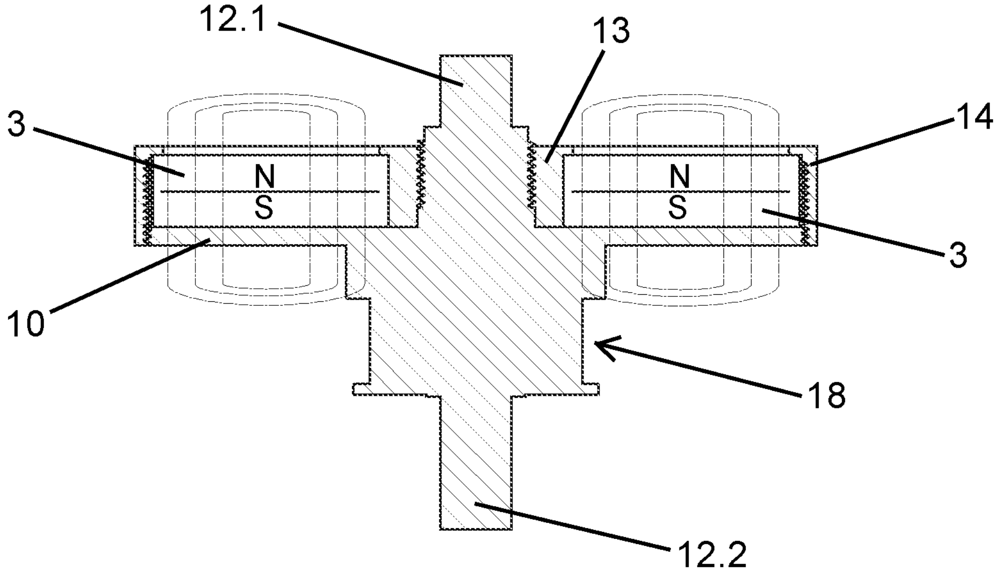

FIG. 11

INTERNATIONAL SEARCH REPORT	International application No. PCT/ES2017/070654

A. CLASSIFICATION OF SUBJECT MATTER

H05B6/10 (2006.01)

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)
H05B

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)

EPODOC, INVENES,WPI

C. 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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A	CN 201425366Y Y (HONGQUAN ZHANG) 17/03/2010, Abstract from DataBase WPI. Retrieved of EPOQUE [retrieved on 17-01-2018]. figures.	2, 4-7
A	US 2011272399 A1 (BERDUT-TERUEL ELBERTO) 10/11/2011, paragraphs [0052 - 0056]; figure 7.	8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18/01/2018	**(23/01/2018)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer E. Pina Martínez Telephone No. 91 3498552

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/ES2017/070654

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Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- US 5012060 A **[0004]**
- US 7339144 B2 **[0004]**
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