Appeal decision

Appeal No. 2017-18876

Ibaraki, Japan
Appellant Hitachi Automotive Systems, Ltd.

Patent Attorney TODA, Yuji

The case of appeal against the examiner's decision of refusal of Japanese Patent Application No. 2014-194634, entitled "Current Detection Device", [the application published on Apr. 28, 2016: Japanese Unexamined Patent Application Publication No. 2016-65791, the number of claims (4)] has resulted in the following appeal decision:

Conclusion

The examiner's decision is revoked.

The invention of the present application shall be granted a patent.

Reason

No. 1 History of the procedures

The present application is an application filed on Sep. 25, 2014, notice of reasons for refusal was issued as of Feb. 27, 2017, an amendment was made on Apr. 19 of the same year, a decision of refusal was made as of Sep. 26 of the same year (date of delivery: Oct. 3 of the same year), and, against this, an appeal against the examiner's decision of refusal was demanded on Dec. 20 of the same year.

No. 2 Outline of the Examiner's decision

The outline of the Examiner's decision (decision of refusal was made dated Sep. 26, 2017) is as follows.

The inventions according to claims 1-3 of the present application and the invention according to claim 4 of the present application could have been invented with ease by a person having ordinary knowledge in the technical field of the invention (hereinafter, referred to as "a person skilled in the art") based on the following Cited Documents 1-3, and on the following Cited Documents 1-4, respectively, and, therefore, the appellant should not be granted a patent for these under the provisions of Article 29(2) of the Patent Act.

List of Cited Documents, etc.

1. Japanese Unexamined Patent Application Publication No. 2013-117447
2. Japanese Unexamined Patent Application Publication No. 2004-079007
3. Japanese Unexamined Patent Application Publication No. 2008-199876
4. Japanese Unexamined Patent Application Publication No. 2011-185647

No. 3 The Invention

The inventions according to claims 1-4 of the present application (hereinafter, referred to as "Invention 1" to "Invention 4", respectively) are inventions specified by the matters described in claims 1-4 of the scope of claims amended on Apr. 19, 2017, and Invention 1 is an invention as indicated below.

"A current detection device including a current sensor and a magnetic shield that is arranged around the current sensor and has an area, in which a conductor is arranged, inside the magnetic shield, wherein

the magnetic shield comprises a first magnetic shield member and a second magnetic shield member arranged in a manner sandwiching the conductor, wherein

the first magnetic shield member comprises an opposite side wall portion disposed opposite to the second magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite side wall portion toward the second magnetic shield member, wherein

the second magnetic shield member comprises an opposite side wall portion disposed opposite to the first magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite side wall portion toward the first magnetic shield member, wherein

a tip portion of the protruding portion of the first magnetic shield member and a tip portion of the protruding portion of the second magnetic shield member are spaced apart in a direction vertical to protruding directions of the protruding portions and vertical to an extending direction of the conductor with a gap, and overlap with each other in a direction of the protruding directions of the protruding portions, wherein

the first and the second shield members are constituted by laminating a plurality of pieces of lamination steel, and wherein

an overlap portion with the gap is arranged, in order of the current sensor, the conductor, and the overlap portion, side by side in a direction along a plane in parallel with the opposite side wall portion of the first magnetic shield member and with the opposite side wall portion of the second magnetic shield member."

The outlines of Inventions 2-4 are as follows.

Inventions 2-3 are inventions that restrict Invention 1.

The Invention 4 is an invention of a car electric power conversion device provided with the current detection device of Invention 1.

No. 4 Cited Documents and Cited Inventions

1 Regarding Cited Document 1

In the above-mentioned Cited Document 1 cited in the reasons for refusal stated in the Examiner's decision, there are described the following matters (the underlines are given by the body).

A "[0001]

The present invention relates to a current sensor to measure a measured current based on variation of an output signal of a magneto-electric transducer due to a magnetic field induced by the measured current."

B "[0023]

As shown in FIG. 1, a current sensor 100 has, as main parts, a sensor substrate

10, a magneto-electric transducer 20 formed on the sensor substrate 10, a magnetic shield section 30 surrounding respective peripheries of the sensor substrate 10 and a measurement-target conductor 90 through which a measured current flows. The current sensor 100 measures a measured current based on variation of an output signal of the magneto-electric transducer 20 due to the magnetic field (hereinafter, indicated as a measured magnetic field) induced by the measured current. The current sensor 100 according to the present embodiment has a bias magnet 40, a circuit substrate 50, a support substrate 60, a mold resin 70, and a spacer 80." ,in addition to the above-mentioned components 10-30.

C "[0039]

In the case of a configuration in which the height position of a part of the gap in a Z direction and the height position of the sensor substrate in the Z direction are identical, a gap magnetic field is formed also from a gap having a height position different from that of the sensor substrate. Since the direction of this gap magnetic field on a reference line BL is not always a direction orthogonal to the reference line BL, there is a risk that a gap magnetic field in a direction along a forming surface 10a is applied to the magneto-electric transducer 20. When such gap magnetic field is applied, a resistor value of the magneto-electric transducer 20 varies due to the gap magnetic field, and thus there is a risk that accuracy of current detection degrades.

[0040]

Against this, in the present embodiment, all height positions of a gap 33 in the Z direction and the height position of the sensor substrate 10 in the Z direction are identical. In this case, a gap magnetic field to be applied to the magneto-electric transducer 20 in a direction along the forming surface 10a is suppressed, and thus degradation of accuracy of current detection is suppressed."

D "[0081]

Hereinafter, the fourth embodiment will be described based on FIG. 10. FIG. 10 is a sectional view indicating a skeleton framework of a current sensor according to the fourth embodiment, and corresponds to FIG. 1 shown in the first embodiment.

[0082]

Since the current sensor according to the fourth embodiment has a lot of matters in common with each of the above-mentioned embodiments, description will hereinafter be made focusing on different portions, and detailed description regarding common portions will be omitted. Note that identical reference characters are assigned to elements that are identical with the elements indicated in each of the above-mentioned embodiments.

[0083]

The current sensor 100 according to the present embodiment has features in the constitution of the magnetic shield section 30 and the position of the sensor substrate 10. As shown in FIG. 10, the magnetic shield section 30 has an upper shield 36 and a lower shield 37, and each of the shields 36 and 37 has a box shape having a single opening. The space for housing the sensor substrate 10 is constituted in an aspect that the distance between external wall surfaces of the side walls of the upper shield 36 is shorter than the distance between internal wall surfaces of the side walls of the lower shield 37, the inner surfaces of the bottom parts of the shields 36 and 37 are disposed opposite to each other, and the side walls of the upper shield 36 are located in the storage space of the lower shield 37. Then, the outside faces of the side walls of

the upper shield 36 and the inner surfaces of the side walls of the lower shield 37 face each other in a direction along x-y plane to constitute the gap 33. On the facing surfaces of the shields 36 and 37 constituting the gap 33, a gap magnetic field occurs. As shown in FIG. 10, the sensor substrate 10 departs in the Z direction from the occurrence site of the gap magnetic field, and its periphery is surrounded by the upper shield 36. Note that the side walls of the shields 36 and 37 mentioned above correspond to the extending portion described in [4-1]."

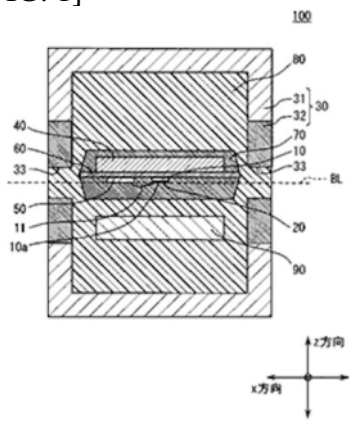
E "[0084]

The farther the distance from the facing surfaces of the shields 36 and 37 that are the occurrence center of gap magnetic field is, the coarser the density distribution of the gap magnetic field is. In contrast, in the present embodiment, the sensor substrate 10 departs in the Z direction from the occurrence center of the gap magnetic field. For that reason, in comparison with a constitution in which a sensor substrate is in a same position with the occurrence center of a gap magnetic field in the Z direction, application of a gap magnetic field to the sensor substrate 10 is suppressed."

In view of D based on the above B, it is recognized that there is described the following invention (hereinafter, referred to as "Cited Invention") in Cited Document 1.
"A current sensor 100 comprising: a sensor substrate 10; a magneto-electric transducer 20 formed on the sensor substrate 10; a magnetic shield section 30 surrounding peripheries of each of the sensor substrate 10 and a measurement-target conductor 90 through which a measured current flows, the current sensor 100 being configured to measure a measured current based on variation of an output signal of the magneto-electric transducer 20 due to a magnetic field induced by the measured current, wherein

the magnetic shield section 30 has an upper shield 36 and a lower shield 37, the space for housing the sensor substrate 10 is constituted in an aspect that the distance between external wall surfaces of the side walls of the upper shield 36 is shorter than the distance between internal wall surfaces of the side walls of the lower shield 37, the inner surfaces of the bottom parts of the shields 36 and 37 are disposed opposite to each other, and the side walls of the upper shield 36 are located in the storage space of the lower shield 37, and a gap 33 is constituted in a manner that outside faces of the side walls of the upper shield 36 and inner faces of the side walls of the lower shield 37 face each other."

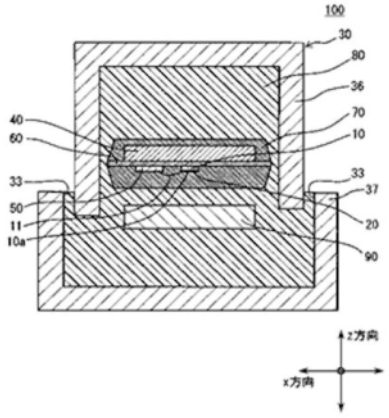
[FIG. 1]



Z 方向 Z direction

X 方向　X direction

[FIG. 10]



Z 方向　Z direction
X 方向　X direction

2 Regarding Cited Document 2

As viewed from the statements of [0024] of the above-mentioned Cited Document 2 cited in the Reasons for refusal stated in the Examiner's decision, it is recognized that there is described a technical matter to make a shield member be of a laminated structure by a plurality of plate-like members so as to suppress an eddy current induced in the shield member in Cited Document 2.

3 Regarding Cited Document 3

As viewed from the statements of [0034] and in FIG. 6 of the above-mentioned Cited Document 3 cited in the Reasons for refusal stated in the Examiner's decision, it is recognized that there is described a technical matter to make a shield member be of a laminated structure so as to suppress an eddy current induced in the shield member in Cited Document 3.

4 Regarding Cited Document 4

As viewed from the statements of paragraphs [0011]-[0012] of the above-mentioned Cited Document 4 cited in the Reasons for refusal stated in the Examiner's decision, it is recognized that there is described a technical matter that a current sensor is provided between a terminal connected to an in-vehicle motor and a power module in Cited Document 4.

No. 5 Comparison / Judgment

1 Regarding Invention 1

(1) Comparison

When Invention 1 and Cited Invention are compared, the following matters can be stated.

A　"The magneto-electric transducer 20", "the measurement-target conductor

90", "the magnetic shield section 30", and "the current sensor 100" of Cited Invention respectively correspond to "current sensor", "conductor", "magnetic shield", and "current detection device" of Invention 1, and thus Invention 1 and Cited Invention are identical in a point of being "a current detection device including a current sensor and a magnetic shield that is arranged around the current sensor and has an area, in which a conductor is arranged, inside the magnetic shield".

B "The upper shield 36" and "the lower shield 37" of Cited Invention respectively correspond to "the first magnetic shield member" and "the second magnetic shield member" of Invention 1, and thus Invention 1 and Cited Invention are identical in a point that "the magnetic shield comprises a first magnetic shield member and a second magnetic shield member arranged in a manner sandwiching a conductor".

C Since "the inner surfaces of the bottom parts of the shields 36 and 37 are disposed opposite to each other" in Cited Invention, "the bottom parts of the shields 36 and 37" of Cited Invention can be respectively equal to "opposite wall portions", and, in addition, "the side walls of the upper shield 36" and "the side walls of the lower shield 37" of Cited Invention can be referred to respectively as "a protruding portion protruding from the bottom portion of the upper shield 36 toward the lower shield 37" and "a protruding portion protruding from the bottom portion of the lower shield 37 toward the upper shield 36". Therefore, the constitution of Invention 1 that "the first magnetic shield member comprises an opposite side wall portion disposed opposite to the second magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite side wall portion toward the second magnetic shield member, wherein the second magnetic shield member comprises an opposite side wall portion disposed opposite to the first magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite side wall portion toward the first magnetic shield member," and the above-mentioned constitution of Cited Invention are common in a point that "the first magnetic shield member comprises an opposite wall portion disposed opposite to the second magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite wall portion toward the second magnetic shield member, and the second magnetic shield member comprises an opposite wall portion disposed opposite to the first magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite wall portion toward the first magnetic shield member".

D Cited Invention is one in which "a gap 33 is constituted in a manner that outside faces of the side walls of the upper shield 36 and inner faces of the side walls of the lower shield 37 face each other", and, when the description of FIG. 10 is combined, it is recognized that "a tip portion of the protruding portion of the first magnetic shield member and a tip portion of the protruding portion of the second magnetic shield member are spaced apart in a direction vertical to protruding directions of the protruding portions and vertical to an extending direction of the conductor with a gap, and overlap with each other in a direction of the protruding directions of the protruding portions" ,as with Invention 1.

Therefore, it can be said that the following Corresponding features and Different features exist between Invention 1 and Cited Invention.

(Corresponding features)
"A current detection device including a current sensor and a magnetic shield that is arranged around the current sensor and has an area, in which a conductor is arranged, inside the magnetic shield, wherein

the magnetic shield comprises a first magnetic shield member and a second magnetic shield member arranged in a manner sandwiching a conductor, wherein

the first magnetic shield member comprises an opposite wall portion disposed opposite to the second magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite wall portion toward the second magnetic shield member, wherein

the second magnetic shield member comprises an opposite wall portion disposed opposite to the first magnetic shield member in a manner sandwiching the conductor, and a protruding portion protruding from the opposite wall portion toward the first magnetic shield member, and wherein

a tip portion of the protruding portion of the first magnetic shield member and a tip portion of the protruding portion of the second magnetic shield member are spaced apart in a direction vertical to protruding directions of the protruding portions and vertical to an extending direction of the conductor with a gap, and overlap with each other in a direction of the protruding directions of the protruding portions."

(Different features)
(Different feature 1)

A point that the opposite wall portion is "the opposite side wall portion" in Invention 1, and "an overlap portion with the gap is arranged, in order of the current sensor, the conductor, and the overlap portion, side by side in a direction along a plane in parallel with the opposite side wall portion of the first magnetic shield member and with the opposite side wall portion of the second magnetic shield member", whereas, Cited Invention is not such an invention.

(Different feature 2)

A point that, in Invention 1, "the first and the second shield members are constituted by laminating a plurality of pieces of lamination steel", whereas, in Cited Invention, "each of the shields 36 and 37" is not made in this way.

(2) Judgment on the Different features

When the above-mentioned Different feature 1 is examined, Cited Invention is, as is observed in FIG. 10 of Cited Document 1, an invention in which the magneto-electric transducer 20 and the measurement-target conductor 90 are located in a longitudinal direction, and the gap 33 is arranged beside these, and the gap 33 is provided also in a laterally spaced apart manner. Then, seen from the statements of paragraphs [0039], [0040], and [0084] of Cited Document 1, the above arrangement was adopted so as to cause a gap magnetic field to be applied to the sensor substrate 10 to be suppressed by departing the sensor substrate 10 further in a height direction from the occurrence center of a gap magnetic field, while making the first embodiment, in which all height positions (positions in the Z direction described in FIG. 1 and FIG. 10) of the gap 33 (arranged beside the magneto-electric transducer 20 and the measurement-target conductor 90) and the height position of the sensor substrate 10 are identical, be the basic constitution.

From the above, a motive to make the magneto-electric transducer 20, the measurement-target conductor 90, and the gap 33 be of the arrangement like Invention 1 mentioned above cannot be found in Cited Invention.

Therefore, it cannot be said that a person skilled in the art could have easily conceived the matters specifying the invention of Invention 1 concerning the above-mentioned Different feature 1 in Cited Invention

Also, Cited Documents 2-4 are not ones that suggest making Cited Invention have the matters specifying the invention of Invention 1 concerning the above-mentioned Different feature 1 in Cited Invention.

Therefore it cannot be said that Invention 1 could have been invented with ease by a person skilled in the art based on Cited Documents 1-4 without examining the above-mentioned Different feature 2.

2 Regarding Inventions 2-3

Invention 2-3 are inventions that restrict Invention 1, and, therefore, it cannot be said that these could have been invented with ease by a person skilled in the art based on Cited Documents 1-4 by the reason similar to that for Invention 1.

3 Regarding Invention 4

Since Invention 4 is an invention of a car electric power conversion device provided with a current detection device of Invention 1, it cannot be said that it could have been invented with ease by a person skilled in the art based on Cited Documents 1-4 by the reason similar to that for Invention 1.

No. 6 Regarding Examiner's decision

Inventions 1-4 are ones having the matters that "an overlap portion with the gap is arranged, in order of the current sensor, the conductor, and the overlap portion, side by side in a direction along a plane in parallel with the opposite side wall portion of the first magnetic shield member and with the opposite side wall portion of the second magnetic shield member", and it cannot be said that it could have been invented with ease even by a person skilled in the art based on Cited Documents 1-4 cited in the Decision of refusal. Accordingly, the reason of Examiner's decision cannot be maintained.

No. 7 Closing

As described above, the application cannot be rejected due to the reasons of the Examiner's decision.

In addition, no reasons for refusal were found beyond that.

Therefore, the appeal decision shall be made as described in the conclusion.

Aug. 20, 2018

Chief administrative judge: SHIMIZU, Minoru
Administrative judge: NAKATSUKA, Naoki
Administrative judge: NAKAMURA, Setsushi