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**Datasheet for the decision
of 27 September 2016**

Case Number: T 0046/14 - 3.2.01

Application Number: 09158443.3

Publication Number: 2112051

IPC: B62D5/04

Language of the proceedings: EN

Title of invention:
Steering control apparatus

Patent Proprietor:
JTEKT Corporation

Opponent:
ThyssenKrupp Presta AG

Headword:

Relevant legal provisions:
EPC Art. 54(1), 56

Keyword:
Novelty - (yes)
Inventive step - (yes)

Decisions cited:

Catchword:



Beschwerdekammern
Boards of Appeal
Chambres de recours

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Case Number: T 0046/14 - 3.2.01

D E C I S I O N
of Technical Board of Appeal 3.2.01
of 27 September 2016

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted on 5 November 2013 rejecting the opposition filed against European patent No. 2112051 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman G. Pricolo
Members: H. Geuss
O. Loizou

Summary of Facts and Submissions

- I. The appeal is directed against decision of the Opposition Division of the European Patent Office posted on 5 November 2013 rejecting the opposition filed against European patent No. 2 112 051 pursuant to Article 101(2) EPC.
- II. The opponent filed an appeal and requested to set aside the decision of the opposition division and to revoke the patent in its entirety. The appellant (opponent) did not request oral proceedings.

With the statement of grounds of appeal, received at the EPO on 4 March 2014, the appellant objected the subject-matter of independent claims 1 and 2 respectively, in view of:

- lack of novelty with respect to
DE 10 2004 713 A1 (D1),
- lack of inventive step with respect to the
combination of D1 and
JP 2008-72865A (D11), filed together with machine
translation D11a with the statement of grounds of
appeal,
- lack of inventive step with respect to the
combination of D11 and each of
DE 10 2005 001 703 A1 (D2),
JP 6053368U (D3),
DE 102 23 139 A1 (D4),
JP 2008049780A (D5),
US 6,194,849B1 (D7),
WO 02/094636A1 (D8),
DE 3688438 T2 (D9).

III. With its letter of reply, received at the EPO on 18 July 2014, the respondent requested the dismissal of the appeal, in the alternative the maintenance of the patent in amended form according to one of the 1st to 4th auxiliary requests, filed during the proceedings before the opposition division, or further according to one of the 5th to 8th auxiliary requests filed with the letter of reply.

The respondent requested, subsidiarily, oral proceedings.

IV. The appellant did not file further submissions in response to the respondent's reply.

V. Claim 1 of the patent as granted reads as follows:

A steering control apparatus (40) including a direct current power source (92, 93) installed in a vehicle (10),
a three-phase alternating current motor (19) serving as a driving source of an electric power steering apparatus (11), and
a motor driving circuit (43) provided between the direct current power source (92,93) and the three-phase alternating current motor (19) so as to generate a three-phase alternating current (I_u, I_v, I_w) from an output of the direct current power source (92,93) and conduct the generated three-phase alternating current (I_u, I_v, I_w) to the three-phase alternating current motor (19), comprising:

an emergency switching element (51,52) which is provided on at least two phases (42V,42W) of a three-phase power supply line (42U,42V,42W)

connected to the three-phase alternating current motor (19) within the motor driving circuit (43), and which is turned off when an abnormality occurs such that the motor driving circuit (43) and the three-phase alternating current motor (19) are disconnected,

characterized in that

the emergency switching element (51,52) is a MOSFET, the MOSFETs are provided in pairs in each of the two phases (42V,42W) of the three-phase power supply line (42U,42V,42W), and parasitic diodes (51D,52D) of the pairs of MOSFETs are disposed in opposite orientations to each other; and

an emergency turn off control unit (44,PG1) for sequentially turning off the MOSFETs through which no current is flowing or the MOSFETs through which a current oriented to turn the parasitic diodes (51D,52D) on is flowing, the emergency turn off control unit turn off all of the MOSFETs when an abnormality occurs (51,52).

Claim 2 of the patent as granted reads as follows:

A steering control apparatus (40) including a direct current power source (92, 93) installed in a vehicle (10),

a three-phase alternating current motor (19) serving as a driving source of an electric power steering apparatus (11), and

a motor driving circuit (43) provided between the direct current power source (92, 93) and the three-phase alternating current motor (19) so as to generate a three-phase alternating current (I_u, I_v, I_w) from an output of the direct current power source (92, 93) and conduct the generated three-phase alternating current (I_u, I_v, I_w) to the three-phase alternating current motor (19), comprising:

an emergency switching element (59) which is provided on a three-phase power supply line (42U, 42V, 42W) connected to the three-phase alternating current motor (19) within the motor driving circuit (43), and which is turned off when an abnormality occurs such that the motor driving circuit (43) and the three-phase alternating current motor (19) are disconnected,

characterized in that

the emergency switching element (59) is a MOSFET, the MOSFET is provided singly in all three phases (42U, 42V, 42W) of the three-phase power supply line (42U, 42V, 42W), and parasitic diodes (59D) of all of the MOSFETs are disposed in an identical orientation relative to the three-phase alternating current motor (19); and

an emergency turn off control unit (44, PG2) for sequentially turning off the MOSFETs through which no current is flowing or the MOSFETs through which a current oriented to turn the parasitic diode (59D) on is flowing, the emergency turn off control unit turn off all of the MOSFETs when an abnormality occurs (59).

VI. The opposition division held that the subject-matter of independent claims 1 and 2 as granted is novel with respect to document D1, as this document does not disclose the feature of an emergency turn off control unit for sequentially turning off the MOSFETs through which no current is flowing or the MOSFETs through which a current oriented to turn the parasitic diodes (51D,52D) on is flowing. The opposition division stated further that the "or" combination in this feature defines merely two possible directions for the current's flow but not two alternative embodiments.

Further, the opposition division pointed out that D2,

D4 and D5 do not show the above-mentioned feature either, and that the claimed subject-matter involved an inventive step over the cited prior art, in particular when starting from D1 as the closest prior art.

VII. The appellant's submissions in the statement of grounds of appeal may be summarized as follows:

The subject-matter of claim 1 as granted lacks novelty.

The feature of claim 1 that, in the Opposition Division's view, confers novelty over D1 (feature 1.8 according to the structuring of features in the statement of grounds of appeal, pages 2 and 3), defines two alternative embodiments of the invention, namely a first embodiment in which the MOSFETs through which no current is flowing are turned off, and a second embodiment in which the MOSFETs through which a current oriented to turn the parasitic diodes (51D,52D) on is flowing are turned off.

The skilled person knows that in cut-off situations voltage peaks may occur, and that these always occur when blocking a current through a MOSFET, as the current cannot change abruptly (law of Lenz). Therefore the skilled person would either select sufficient dimensioned semiconductor devices, or turn off the MOSFET if the current is zero or close to zero. In any case, it belongs to the skilled person's common general knowledge to turn off the MOSFETs either when the current flowing through it is zero or close to zero, or when the current flows through the parasitic diode associated to the MOSFET, in which case the MOSFET is already turned off. This measure has the effect of automatically turning off sequentially all MOSFETs of the different phases.

The same reasoning applies for independent claim 2.

Document D11 (with reference to the machine translation D11a) relates to an emergency switching for a three-phase electrical motor. Although D11 does not disclose that the emergency switching is used for the motor of a steering control apparatus of a vehicle, all the other features of claim 1 are known therefrom. In particular, having regard to the circuit shown in Fig. 9, D11 discloses that MOSFETs 341 and 342 are sequentially turned off. Under the assumption that D1 does not disclose feature 1.8, it would be obvious for a skilled person to apply this teaching of D11 to the device of D1 thereby arriving at the subject-matter of claim 1 without the exercise of an inventive activity. Documents D2, D3, D4, D5, D7 to D9 disclose steering control systems with emergency switching elements to avoid braking current loops. Therefore, as explained when starting from D1, the combination of one of these documents with D11 would also render the invention according to claim 1 obvious.

The same arguments apply for independent claim 2, as feature 2.8 thereof corresponds to feature 1.8 of claim 1.

VIII. The respondent's (patent proprietor) rebuttal is essentially the following:

Document D11 should not be admitted into the proceedings since it is late filed and not relevant.

The subject-matter of claims 1 and 2, respectively, is novel over D1.

According to D1, paragraph [0021] the gate driver circuit provides a signal to the switches 154, 156, 158 to cause them not to conduct anymore. This paragraph

does not disclose different switch-off timings for each switch. In fact, D1 does not disclose a control of the MOSFETs of the emergency switching elements at all; in particular, there is no mention at all of a timing control of the switching elements. The problem which is solved by the motor control according to D1 is the reduction of the disadvantageously large number of components and this problem is solved in D1 by an arrangement of single MOSFETs in each of the three phases. Thus, D1 does not identify the problem of the risk of damage of the emergency switching elements which is the problem to be solved by the present invention.

D11 does not solve this problem either. The general object of D11 is the prevention of an inter-phase short circuit caused by a solid state switch which carried out a conduction failure (cf. paragraph [0004] of D11a). D11 is directed to a drive motor of a hybrid or electric car. On the contrary, the object of the invention in suit is the prevention of a brake current loop resulting in steering resistance of a steering assist motor. It is irrelevant whether a skilled person could arrive at the combination of features according to claim 1, or claim 2, but instead it is necessary that the skilled person would combine these documents and the teachings thereof in order to solve a technical problem.

Documents D4, D5, D8 and D9 are of lower relevance than D1. D9 does not disclose a three phase load and D8 does even not show a semiconductor switch.

D2, D3 and D7 differ from D11 to such an extent that it is questioned how inventive step of independent claim 1 respectively claim 2 could be challenged.

Reasons for the Decision

1. The appeal is admissible.
2. The invention as defined in independent claims 1 and 2 as granted is novel over document D1, Article 54 (1) EPC.
 - 2.1 The appellant's arguments in this respect correspond to the arguments submitted in first instance proceedings and dealt with by the Opposition Division in the impugned decision.

The Board follows in this respect the reasoning of Opposition Division, according to which the subject-matter of claims 1 and 2 differs from the device of document D1 by feature 1.8 and 2.8, respectively, (reference is made to the structuring of features, statement of grounds of appeal, pages 2 and 3), defining that the apparatus comprises

an emergency turn off control unit for sequentially turning off the MOSFETs through which no current is flowing or the MOSFETs through which a current oriented to turn the parasitic diodes (51D, 52D) on is flowing.

- 2.2 Firstly, the Board agrees with the Opposition Division's view that independent claims 1 and 2 as granted do not define two alternative embodiments of a steering control apparatus by using the term "or" in feature 1.8, respectively 2.8. Rather, the claims should be read as defining that the steering control apparatus is provided with an emergency turn off

control unit which is able to handle two situations:

- first situation: turning off the MOSFETs through which no current is flowing, and
- second situation: turning off the MOSFETs through which a current oriented to turn the parasitic diodes (51D,52D) on is flowing.

Since the moment at which the first or the second situation arises is different for each phase of the three-phase alternating current, the turning off is carried out sequentially.

This view is supported by the patent description, cf. paragraph [0008], in which it is explained that both features in combination play a role in solving the problem of avoiding spike voltages.

2.3 Secondly, there is no direct and unambiguous disclosure in document D1 with respect to an emergency switching off; D1 is completely silent about this feature. In particular, D1 does not disclose any timing control of the MOSFETs. In D1 (cf. paragraph [0021], the last eight lines) it is merely explained that the driver circuit provides a signal to the unidirectional switches (154,156,158) to cause the unidirectional switches not to conduct anymore, but it is not disclosed that said signal should provide different switch-off timings for each respective unidirectional switch such that a sequential switching-off occurs.

2.4 The Board additionally notes that, by the appellant's own admission (see page 6, fourth paragraph, of the grounds of appeal), problems with peak voltages when switching-off MOSFETs might be avoided by selecting sufficient dimensioned MOSFETs, whereby the above-mentioned general disclosure in D1 that the

unidirectional switches (MOSFETs) are caused not to conduct anymore cannot in any case be read as implying for the skilled person the sole possibility (i.e. as clearly and unambiguously disclosing) that switching off is made when the current flowing through a MOSFET is zero or close to zero, or when the current flows through the parasitic diode associated to the MOSFET.

3. The subject-matter of claim 1 involves an inventive step according to Article 56 EPC.
 - 3.1 In this respect the Board follows the respondent's argument that the combination of documents D1 and D11 does not render the subject-matter obvious.
 - 3.2 Document D1 is the closest prior art and discloses all features of claim 1 beside feature 1.8, see point 2, above.
 - 3.3 The problem solved with the differing feature is to avoid high voltage peaks as a result of an emergency turn off the three-phase alternating current motor when abnormality occurs.
 - 3.4 The appellant submits that D11 discloses a turn off device which turns off the MOSFETs in case no current is flowing or the current is flowing oriented to turn on the parasitic diodes. This general teaching of D11 combined with D1 leads to the invention according to claim 1.
 - 3.5 The general technical concept of turning off the semiconductor switches in a situation in which the current through the MOSFET is zero is indeed disclosed in D11.

However, the Board cannot recognize any motivation for the skilled person to combine documents D1 and D11. The invention of document D1 solves the problem of the reduction of the disadvantageously large number of components (cf. paragraph [0006]) and this problem is solved by an arrangement of single MOSFETs in each of the three-phase power supply lines. D1 does not touch the problem of spike voltages when turning off the MOSFETs.

- 3.6 Document D11 does not deal with disconnecting a motor driving circuit from a three-phase electrical motor in order to avoid brake current loop resulting in steering resistance of a steering assist motor but to prevent an inter-phase short circuit caused by a solid state switch which carried out a conduction failure (see paragraph [0004] of D11a).

Thus, even if the skilled person - starting from D1 - were to define the problem of reducing spike voltage in switch-off situations, he would not consider D11 since the problem dealt with in D11 (i.e. to prevent an inter-phase short circuit) is not comparable to the problem solved in the contested invention (i.e. to avoid spike voltage). Hence, the Board agrees with the submissions of the respondent that for the assessment of inventive step it is irrelevant that also D11 discloses the above-mentioned distinguishing feature, because what counts is that it is disclosed in D11 for solving a problem which is completely different than that underlying the contested invention.

4. The appellant submitted in very general terms that since documents D2, D3, D4, D5, D7 to D9 disclose steering control systems with emergency switching elements to avoid braking current loops, as does D1,

also the combination of one of these documents with D11 would render the invention according to claim 1 obvious. These documents being analogous to D1, it follows from the above that also their combination with D11 cannot challenge inventive step of the subject-matter of claim 1 as granted.

5. As regards independent claim 2, the appellant relies on the same argumentation as submitted for claim 1, since the subject-matter of claim 2 differs from D1 by feature 2.8, which corresponds to feature 1.8 of claim 1, and reads:

an emergency turn off control unit (44, PG2) for sequentially turning off the MOSFETs through which no current is flowing or the MOSFETs through which a current oriented to turn the parasitic diode (59D) on is flowing, the emergency turn off control unit turn off all of the MOSFETs when an abnormality occurs (59).

Under these circumstances, the Board can only conclude that, for the same reasons given for claim 1, also the subject-matter of claim 2 involves an inventive step.

6. Since the appellant's argument which relies on document D11 is not convincing, the question of whether D11 and D11a should have been admitted into the proceedings (Article 12(4) Rules of Procedure of the Boards of Appeal) needs not be decided by the Board.

7. Finally, the Board notes that the present decision is taken in written proceedings, in accordance with Article 12(3) RPBA. It is taken well after the filing of the reply to the grounds of appeal, which was received at the EPO on 18 July 2014. The appellant, who did not request oral proceedings, had ample time for

submitting further submissions in reaction thereto. The prerequisites of Article 116 and 113 are thus met.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



N. Schneider

G. Pricolo

Decision electronically authenticated