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- with international search report (Art. 21(3))
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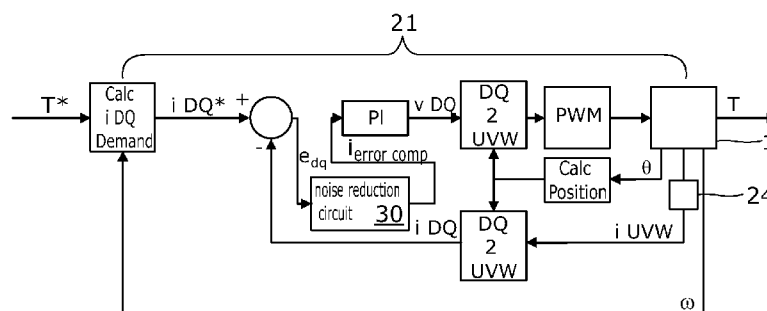
(54) **Title:** MOTOR CONTROL FOR ELECTRIC POWER ASSISTED STEERING SYSTEMS

Figure 1

(57) **Abstract:** A motor control circuit for an electric motor of an electric power assisted steering system of the kind in which a measurement of torque carried by a part of the steering system is used to produce a torque demand signal indicative of a torque to be applied to the steering system by the motor, the control circuit comprising a switching circuit comprising a plurality of electrical switches, and a motor current controller that generates voltage demand signals to be passed to a drive circuit for the switches that in turn generates pulse width modulated switching signals for the switching circuit that cause the switches to selectively connect the phases to a power supply so as to cause current to flow through the phases of the motor. The current controller is responsive to an error signal that represents the difference between a current demand signal and an actual current signal, and a noise reduction circuit adapted to identify an operating condition of the system in which the motor is stationary or rotating at a very low speed, and in the event that the operating condition is identified the noise reduction circuit is adapted to reduce the response of the controller to variations in the error signal.

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2014/050645

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H02P23/03 B62D5/04  
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)  
B62D H02P

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. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | US 2006/012323 A1 (ENDO SHUJI [JP] ET AL)<br>19 January 2006 (2006-01-19)<br>paragraphs [0002], [0006], [0087],<br>[0118]; figures 2,12,16<br>paragraph [0101] - paragraph [0104];<br>figure 14<br>paragraph [0065] | 1-5,7-15              |
| A         | JP 2007 137272 A (JTEKT CORP)<br>7 June 2007 (2007-06-07)<br>abstract<br>paragraph [0031]                                                                                                                           | 8                     |
| A         | US 2008/154462 A1 (YAMAMOTO SATOSHI [JP])<br>26 June 2008 (2008-06-26)<br>paragraph [0109] - paragraph [0115];<br>figures 1,10                                                                                      | 1-15                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

3 September 2014

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Name and mailing address of the ISA/

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2014/050645

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 16, 17  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

Continuation of Box II.2

Claims Nos.: 16, 17

Independent claims 16,17 do not meet the requirements of Article 6 PCT in that they are not clear. The subject matter of the claims is defined by references to the drawings only, whereas Article 6 PCT specifies that the claims shall define the subject-matter for which protection is sought; see also Rule 6.2(a) PCT. This should be done in terms of the technical features of the invention; Rule 6.3(a) PCT. Since it is unclear which features of the drawings are intended to be included into the claims, a meaningful search of the whole claimed subject-matter could not be carried out (Article 17(2) PCT and PCT Guidelines 9.30).

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2014/050645

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                                                | Publication<br>date                                                |
|-------------------------------------------|---------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| US 2006012323 A1                          | 19-01-2006          | EP 1616774 A2<br>US 2006012323 A1                                                         | 18-01-2006<br>19-01-2006                                           |
| JP 2007137272 A                           | 07-06-2007          | NONE                                                                                      |                                                                    |
| US 2008154462 A1                          | 26-06-2008          | EP 1935753 A1<br>JP 5050520 B2<br>JP 2008149971 A<br>KR 20080058252 A<br>US 2008154462 A1 | 25-06-2008<br>17-10-2012<br>03-07-2008<br>25-06-2008<br>26-06-2008 |